FEBRUARY 1965 35 CENTS

Popular Science

Monthly

LBJ's HEART
What the medics have learned about his— and yours

RACE CARS of the WORLD
—a complete spec chart

WHICH COMPACT FOR YOU?
PS test-drives Falcon, American, Valiant, Chevy II

24 PAGES ON BOATS, HULLS, Ddocks, ETC., ETC.

TINY TV SETS ARE "IN"
A Buyer's Guide

FORD

TWIN I BEAM
INDEPENDENT SUSPENSION

• Front wheels operate independently, each on its own axle • Front axles are forged steel I-beams—like big truck axles • Forged radius rods secure axles to frame siderails • Axles pivot in husky, long-life bushings

New front-end durability
in a revolutionary 2-axle suspension!

Two front axles—that's the big difference in Ford's new Twin-I-Beam suspension! And what a difference they make in pickup durability and ride! Each axle is an I-beam (like the I-beams big-truck axles use) that works independently to smooth the roughest road and give you a new feel of control! Moreover, a forged radius rod holds each axle in position to maintain better wheel alignment, extend tire life!

New engine durability:
biggest straight six, most powerful V-8!

Every engine for '65 is completely new! Standard is a 240 cu. in. economy Six with seven main bearings. Optional are a new 300 cu. in. Big Six—biggest Ford Six ever built—and a 352 cu. in. V-8, most powerful engine ever offered in any Ford pickup! Experience a wonderful difference in pickup response and ride—at your Ford Dealer's!

PRODUCTS OF Ford MOTOR COMPANY

'65 FORD TWIN I BEAM PICKUPS

INDEPENDENT SUSPENSION

BUILT TO LAST LONGER

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Popular Science
Monthly
355 LEXINGTON AVENUE, NEW YORK, N. Y., 10017 • MURRAY HILL 7-3000

To All Newcomers In Today's Advertising Business.

(That means you!)

And me.

And, indeed, everyone -- regardless of age and experience.

For it's become a cliche that advertising is taking on new directions and dimensions at a fantastic rate. What sometimes isn't realized is this: the changes have been so complete that no one has been in this advertising business more than a decade. We're all, in a sense, newcomers.

Advertising's changes, of course, result from the changing world. And this is one important reason why so many alert advertisers are turning to Popular Science Monthly. For it alone among the mass magazines is edited to cover the full sweep and scope of the new world a-coming. It alone sets your advertising solidly in the framework of the future -- and thus enables you to reach the Men With Drive.

These are the new men. Standing squarely in the new world. Anxious to understand it, become part of it, benefit from it. Some are technologists; others are accountants, teachers, salesmen. Most of them are also the neighbor up the street to whom everyone turns for advice when they are buying or building.

The Man With Drive is a good man to have on your side of the street. And you're most likely to meet him in Popular Science.

Cordially,

Charles S. Thorn

Charles S. Thorn
Vice President

SP-1

Urheberrechtlich geschütztes Material

February 1965

Second class postage paid at New York, N. Y., and at additional mailing offices. Entered as second class matter at the Post Office Department, Canada.
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Urheberrecht ch geschützt Mate

PC Perflon OIL RINGS PERFORM

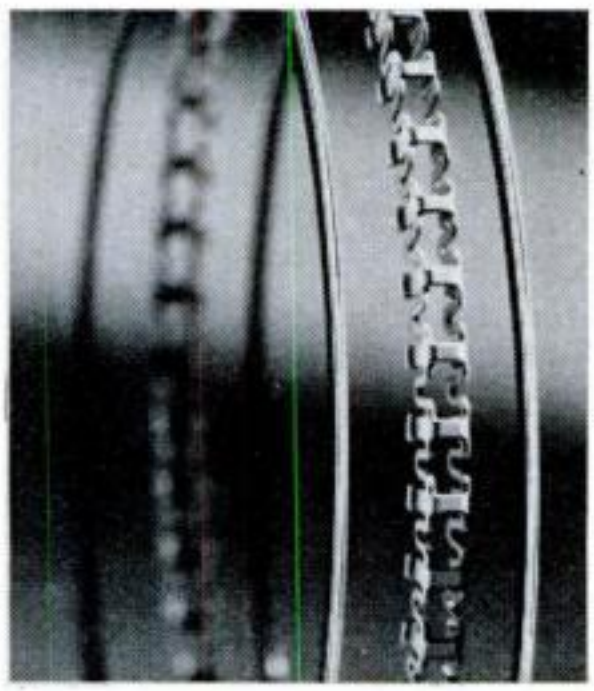
3 WAYS BETTER

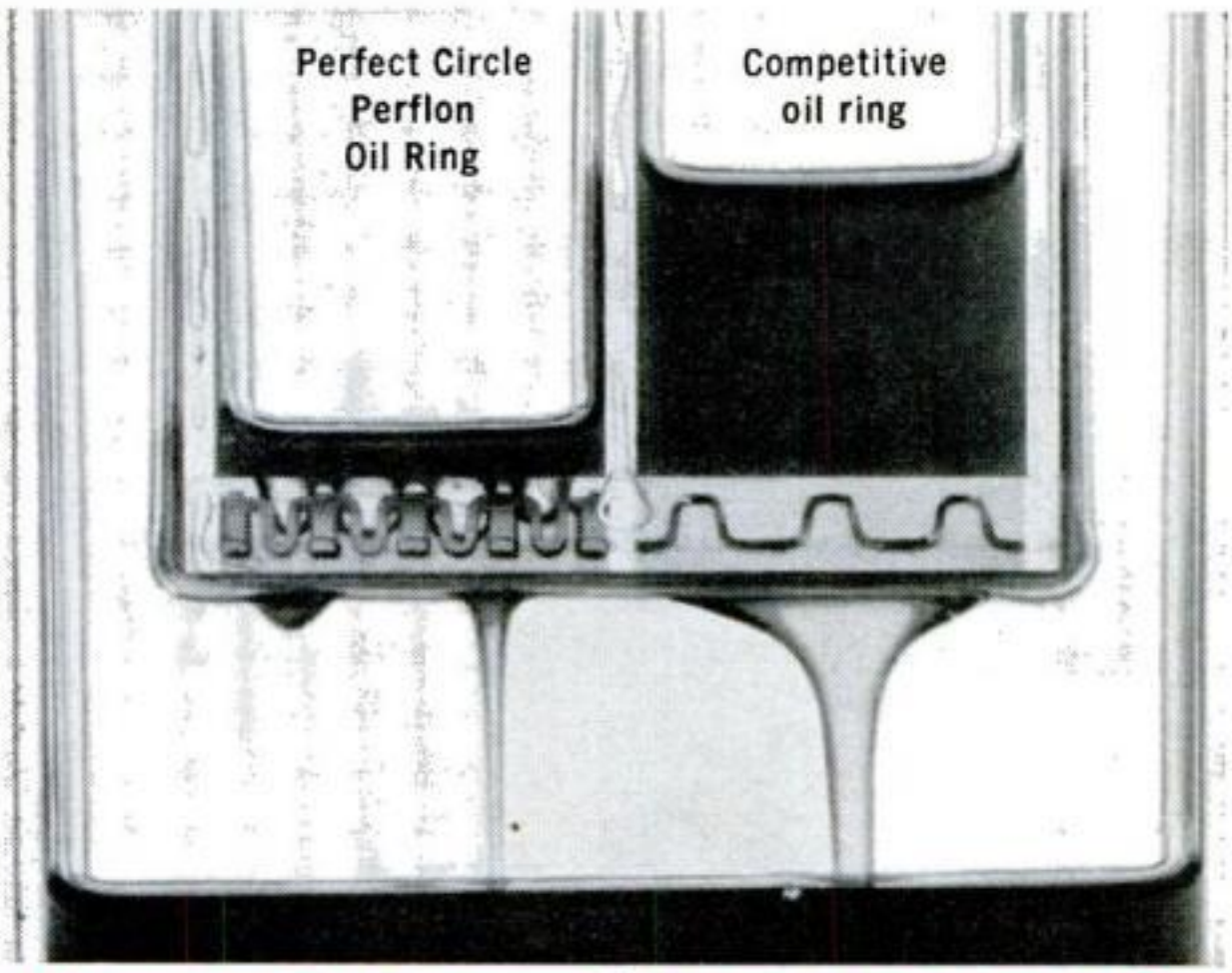
Only PC uses carbon steel, chrome and Teflon for greater strength, longer wear, faster drainage!*

The expander-spacers in new Perflon rings are made of tempered carbon steel and then coated with Teflon, the miracle finish sludge does not stick to. Why carbon steel? Because it gives greater fatigue strength and breakage resistance than other steels, including stainless.

The Teflon coating, plus PC's wide-span slot design, gives you an oil ring that eliminates the clogging and sticking problem.

Other features of the Perflon ring include (1) chrome-plated, tempered steel rails and (2) proper side seal and face seal for effective oil control.





The un-retouched photo above shows a Perflon ring in action. Using equal amounts of the same weight oil, the Perflon ring lets oil drain as much as 160% faster than competitive brands.

Specify the strong, long-wearing rings that prevent carbon and sludge build-ups—Perfect Circle 2 in 1 sets with Perflon oil rings.

**Registered trademark for Du Pont fluorocarbon resin finishes.*

PERFECT CIRCLE

Corporation • Hagerstown, Indiana 47346
A Subsidiary of Dana Corporation

Urheberrechtlich geschütztes Material

Founded in 187:
Vol. 186 No. 2

Popular Science

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Popular Science
Monthly

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Cover photo by Bob Borst

February 1965

Are small cars more dangerous? Read both sides of the story! Page 71.

Now you can store your lathe right in your workbench. Page 180.

Think you know casters? This PS roundup is full of surprises. Page 174.

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Sam Hanks, Indianapolis "500" champion and driving safety expert, says—

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- **50,000 Miles Without Changing Oil.** An exclusive report on a new type of oil purifier for your car, employing a principle used in aircraft engines.

- **How Good Are Those New Tiny Speakers?** PS rates six new low-cost, hi-fi, compact speakers. Results: surprising.

- **How to Be a Successful Inventor.** Here are the answers to how you can cash in on your invention, from a new book by experts Norman Carlisle and K. O. Kessler.

- **All About Suburban Tractors.** This roundup of news and information tells you everything you want to know about these versatile yard machines.

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TROUT FISHER—Aluminum Fishing Boat

CHALLENGER—Fiber Glass Utility Boat

SEA CRUISER—Fiber Glass Day Cruiser

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PS readers talk back

Want to get something off your chest? Write "Readers Talk Back," Popular Science, 355 Lexington Ave., New York, N.Y. 10017.

The Second Deadly Skid

Congratulations on that very fine article, "The Seven Deadly Skids" [Nov.]. I never knew before that the front wheels could lock without the rear locking also. Thanks to you, I recently avoided a skid coming down a big hill when the car ahead stopped suddenly. The rear of my car started to go right. By turning to the right and slightly pumping the brakes, I slowed to a stop without trouble.

LARRY BEAM, Kettering, Ohio.

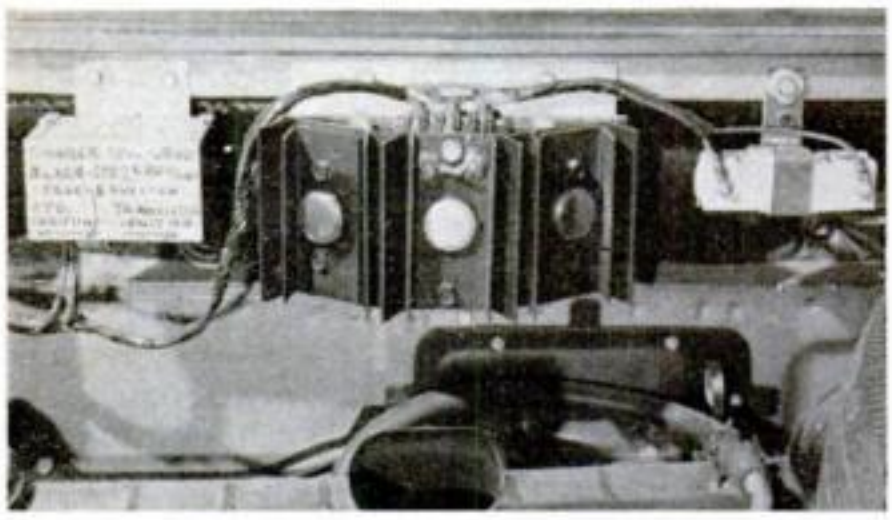
Not Like the Model T

In "Detroit Report" [Dec.] you say that every new Buick needs an average of $35 in repairs after delivery. Other makes may need more. This is shocking. Furthermore, the amount is really higher than that. Some people don't have minor defects fixed, or have it done by someone offering less inconvenience than the two trips and one day out of service required by dealers. When the battery on my '62 Rambler failed after one year, I just bought another from a reliable source. The pro-rated allowance the dealer would have made wouldn't have been worth the trouble.

RAYMOND P. WALLACE, Clifton, N.J.

Transistorized Travel

Here's my version of your low-cost transistor ignition [Mar. '64] installed on a '63 Corvair.



The two studs above the center transistor are 10-watt power diodes (two for 98 cents) used in place of the paralleled diodes called for. Diodes in parallel configuration usually have to be matched to avoid uneven current division. The components on the rear side are sealed in silicone rubber (bathtub calking).

Performance is perfect—with the engine tuned to take advantage of transistor ignition, I am getting 25 m.p.g. at 65 m.p.h. on trips.

FRANK GREENWALD, LaGrange, Ill.

Still Better

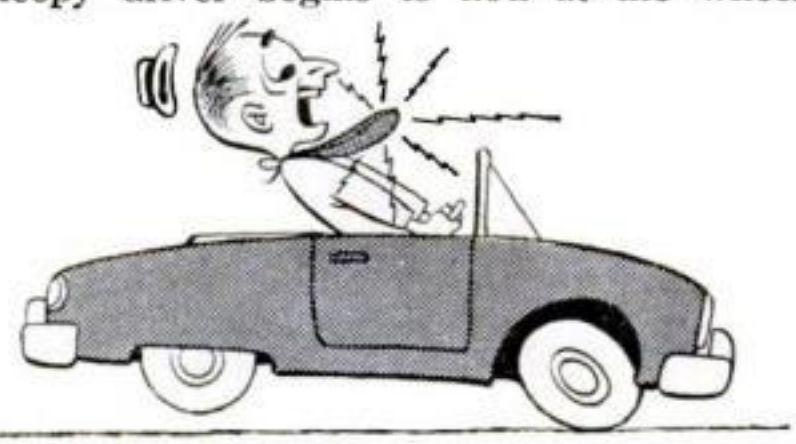
We were pleased with your digest [Dec.] of *Quick and Easy Math* by Isaac Asimov. However, you quote the book price as $3.75. Our edition is $3.

JESSIE LEIGHTON,
Houghton Mifflin Co., Boston.

A bargain at any price.

Wacky Is as Wacky Does

One of the weirdies mentioned in "Wacky Show of Inventors' Brainstorms" [Nov.] sounds pretty wacky to me: the alarm that rings when a sleepy driver begins to nod at the wheel.



The noise of the alarm going off might so frighten a driver he'd lose control of his car.

JAMES MIDDENDORF, New Athens, Ill.

Nothing New Under the Sun

An Alnico magnet for feeding to cows to prevent hardware disease ["Science Newsfront," Nov.] has been manufactured for years by the company I work for—Indiana General Magnetic Division. Rather than minor surgery, we recommend inserting a hollow plastic tube into the cow's stomach to remove the magnet for cleaning. A wire pushed down through the tube hooks onto the magnet.

DAVID O. SCHOLZ, Valparaiso, Ind.

The Glowing Screen

Your television data ["Inside the '65 TVs," Dec.] made good reading, especially your reference to the thin cabinetry of our 23-inch rectangular CRT sets. Most of the industry will be marketing rectangular-tube sets next year and it should be helpful to readers to note its advantages.

You incorrectly listed depth of our rectangular sets as 22 inches—most have a depth of less than 19 inches; largest depth is 20½ inches in one extremely wide set.

RALPH W. JONES, P.R. MGR.
Motorola Inc., Franklin Park, Ill.

. . . The 23-inch Motorolas have a unique automatic degausser which you didn't men-

CONTINUED

Urheberrechtlich geschütztes Material

Right at your doorstep are hundreds of photographs you can sell

Many people earn an extra $25 to $100 a week with their cameras. Here's advice on how you can do the same

By Victor Keppler

I often wonder why more people don't use their cameras to pick up extra money.

Right in your own "backyard," there are hundreds of appealing pictures you can take in your spare time. And all over the country, editors are waiting to buy them.

Where and How to Sell Your Pictures, the "bible" of photographers interested in extra money, lists over 800 publications constantly in the market for good photographs of people, places and events. For example:

Flower Grower pays $50 to $100 for color pictures — $5 to $10 for black-and-white — of flowers, plants, trees. *Mechanix Illustrated* pays $10 to $25 for craft and hobby pictures. *My Baby Magazine* pays $10 to $15 for pictures of children under three. *Golf Digest* pays $10 to $25 for golf scenes. *Plastichrome Postcards* pays $10 to $25 for scenic shots in color.

And you can sell the same picture more than once. As a young man, using a borrowed camera, Arthur d'Arazien shot a mountain scene that he has now sold 18 times, for a total of $5,800. And he still owns it.

A common way to get repeat sales is through stock-photograph agencies, which publish catalogs of good pictures. Each time one of your photographs is ordered, you earn another fee. *Where and How to Sell* lists many such agencies.

Of course, the more professional-looking your photographs, the better your chances of selling them. And now, for the first time, you can be trained, at home, in the professional methods and prized studio secrets of America's most successful photographers.

Ten of them have started the Famous Photographers School. They are: Philippe Halsman, Irving Penn, Alfred Eisenstaedt, Richard Avedon, Bert Stern, Ezra Stoller, Arthur d'Arazien, Richard Beattie, Joseph Costa and Harry Garfield. These men spent three years pouring into a remarkable series of lessons everything they learned in their long, hard climb to the top.

They perfected a teaching method as personal as the tutoring a master photographer gives a promising assistant. Your instructors are all professional photographers, supervised by the School's famous founders. They don't merely tell you how to improve each photograph you send in as part of your assignments — they show you with unique visual critiques. And every critique, every letter of advice, is tailored to your individual goals and problems.

Victor Keppler, Director of the Famous Photographers School, has earned over four million dollars in photography and won dozens of its highest honors.

This familiar scene by Alfred Eisenstaedt was chosen for publication in a leading national magazine. There are dozens of such striking picture possibilities within a few blocks of your home.

Two free books offered by School

To show you opportunities in photography — and how you can be trained to profit by them — our School offers the 160-page book, *Where and How to Sell Your Pictures*, and a 48-page brochure about our Course.

The coupon will bring you these with no obligation. But, as the books are costly, please send for them only if you are seriously interested in learning how your camera can earn you extra income.

Famous Photographers School
Studio 609, Westport, Connecticut

Please send, without cost or obligation, your 48-page brochure and *Where and How to Sell Your Pictures.* I am interested in using my camera to earn money:

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☐ part-time now, full-time later
(please check one)

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Mrs.....Age.....
Miss (circle one and please print)

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City.....

State
County.....& Zip.....

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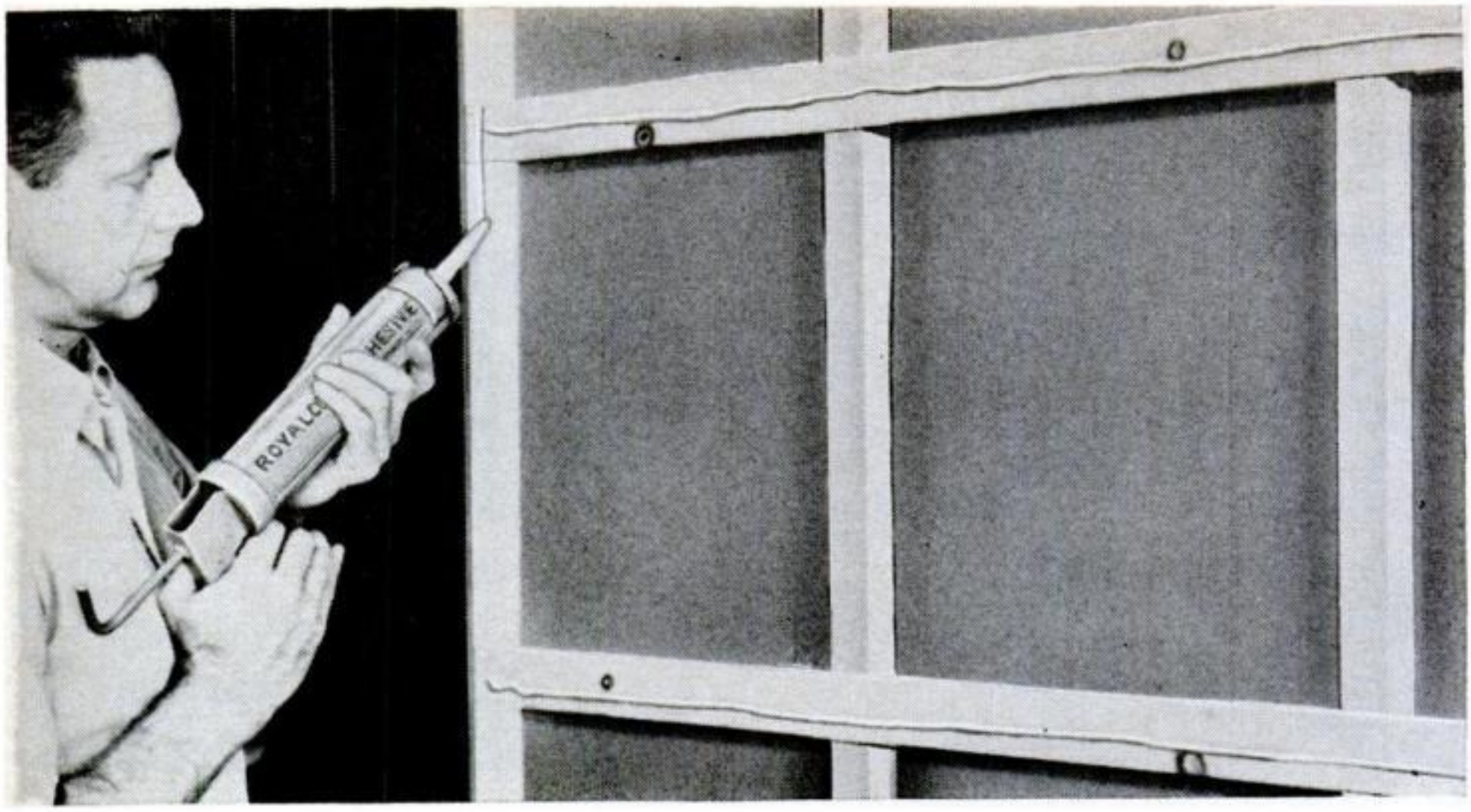
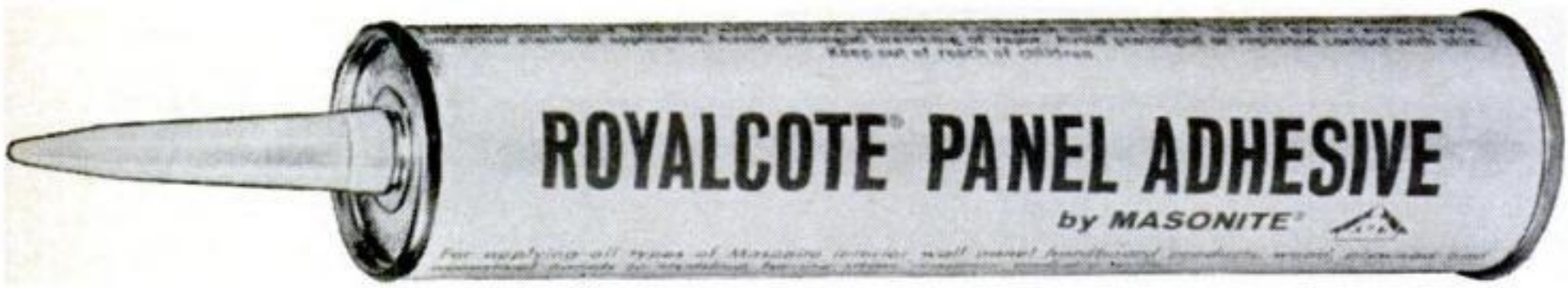


now you can paste panels in place



just by using this cartridge

That's right—no more unsightly nail holes when you use new Royalcote Panel Adhesive. Applied with a standard caulking gun, this powerful contact bond material assures professional jobs. You can even align panels while the cement is tacky.

Royalcote Adhesive can be used on hardboard, plywood, studding, furring strips, masonry and unpainted dry walls. And it works fast—drying time is only 8 to 10 minutes under normal interior conditions.

Get Royalcote Panel Adhesive...and panels ...from your Masonite dealer. (He's listed in the Yellow Pages under Building Materials.)

For best results, follow package instructions closely.

MASONITE *shows the way!*

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Masonite Corporation, Dept. PS-2, Box 777, Chicago 90, Illinois
Please send more information about new Royalcote Panel Adhesive.

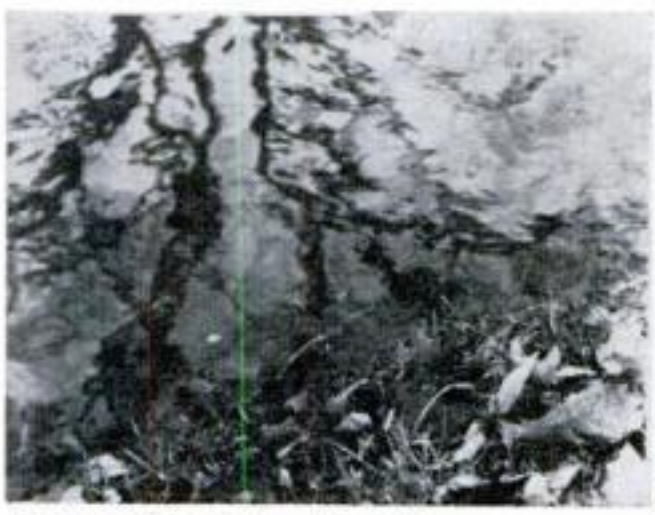
Name_____

Address_____

City_____ County_____ State_____ Zip Code_____

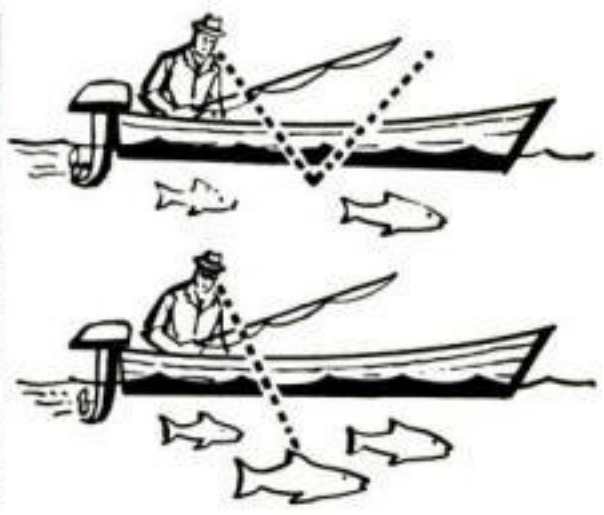
Urheberrechtlich geschütztes Material

NEW FRENCH GLASSES LET YOU SEE FISH ~~BELOW~~ SURFACE OF WATER!



View without Lunette Glasses

Same view with Lunette Glasses



An amazing new invention hit the world 2 years ago, when the first "Lunette Radar" glasses were brought in from France. For the first time, this amazing invention gave fishermen an easy, inexpensive way to see **below** the water surface . . . to spot fish . . . to let a fisherman see what he's doing instead of fishing "blind."

Invented and introduced in Europe, these sensational glasses sold so fast we **never** caught up with the demand. They were written up in one of New York's great newspapers —but with almost no publicity and very little advertising, we were sold out.

GREATEST NEW FISHING INVENTION

What made these glasses the **most-wanted** fishing aid of the year? First, the obvious fact that fishermen can now—for the first time—see below the surface **as they fish**—with no cumbersome equipment or gadgets.

You just slip these Lunette Radar Glasses on—and water that you can't see into at all with the naked eye becomes clear—so you can see for at least 2 ft. to 12 ft. (or more) below the surface!

See photo illustrations above. These were taken with a **camera lens.** With the human eye, you will see even better! Even with a camera, though, you can see how water reflects glare. Without glasses, you see **only** the surface. Put these Lunette Radar Glasses on and you see below the surface! Now fishermen can see fish before they bite. Now you can bring your line close to the fish and watch the movement of line and lure . . . now you can see your line and lure working . . . now you can take your line in faster because you can see fish take your bait. **NOW YOU CAN FISH "SMARTER"—NOW YOU CAN TAKE MORE FISH—EVERY TIME.** With Lunette Radar Glasses you save precious fishing time. You see into holes—even in swift-running streams. You see through brush-piles, weeds—down into lakes, ponds and salt water.

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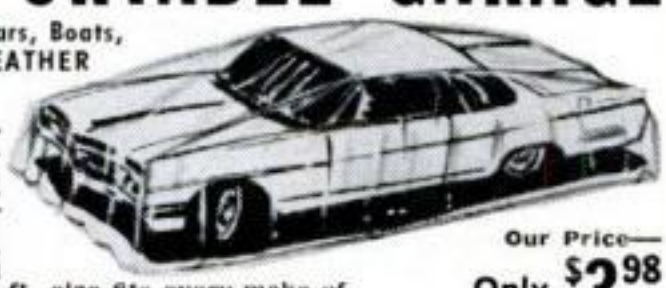

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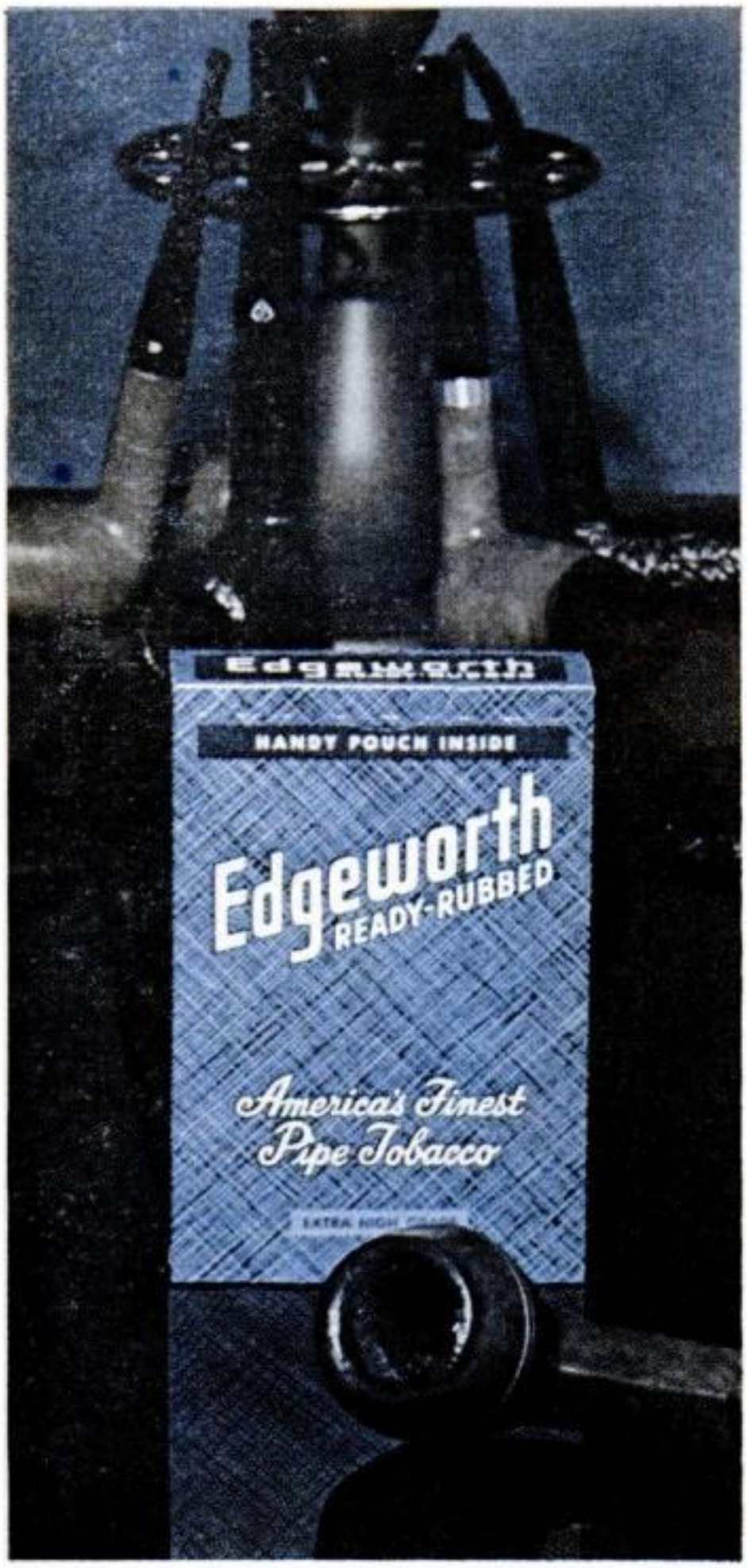

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DORRANCE RIGNEY, Spokane.

Mean Man with a Knitting Needle

Anybody looking for another use for his tape recorder—and incidentally an easy way to please some woman in the family?

My wife is a great knitter, but she finds it hard to read some of the patterns and knit at the same time. I put the directions on a tape. By stopping and starting the recorder with the press switch on the mike, the speed is controlled by the knitter. When repeat rows are needed, the tape instructs her to "go back to row 12 (or whatever) and repeat." It sure made a hit with my wife!

BERNARD YELIN, Southwick, Mass.

Beating Detroit

"Beating the Bounce" [Dec.] ignored the finest suspension in existence—the Citroen air-oil method.

The Citroen has had features for 10 to 30 years that Detroit is just getting around to talking about: front-wheel drive with true pillar suspension and rack-and-pinion steering, disk brakes (scoop-cooled and self-adjusting), built-in jacks, a no-spoke safety wheel, and the best natural air-conditioning system I've ever seen.

How many Detroit cars have wheels held on by just one bolt? A trunk and hood that can be left straight up in an emergency and still leave room for vision? Stainless-steel bumpers? A fully enclosed bottom and belly pan for aerodynamic efficiency? Easily detachable fenders and roof for convenient replacement?

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VAUGHN M. GREENE, San Francisco.

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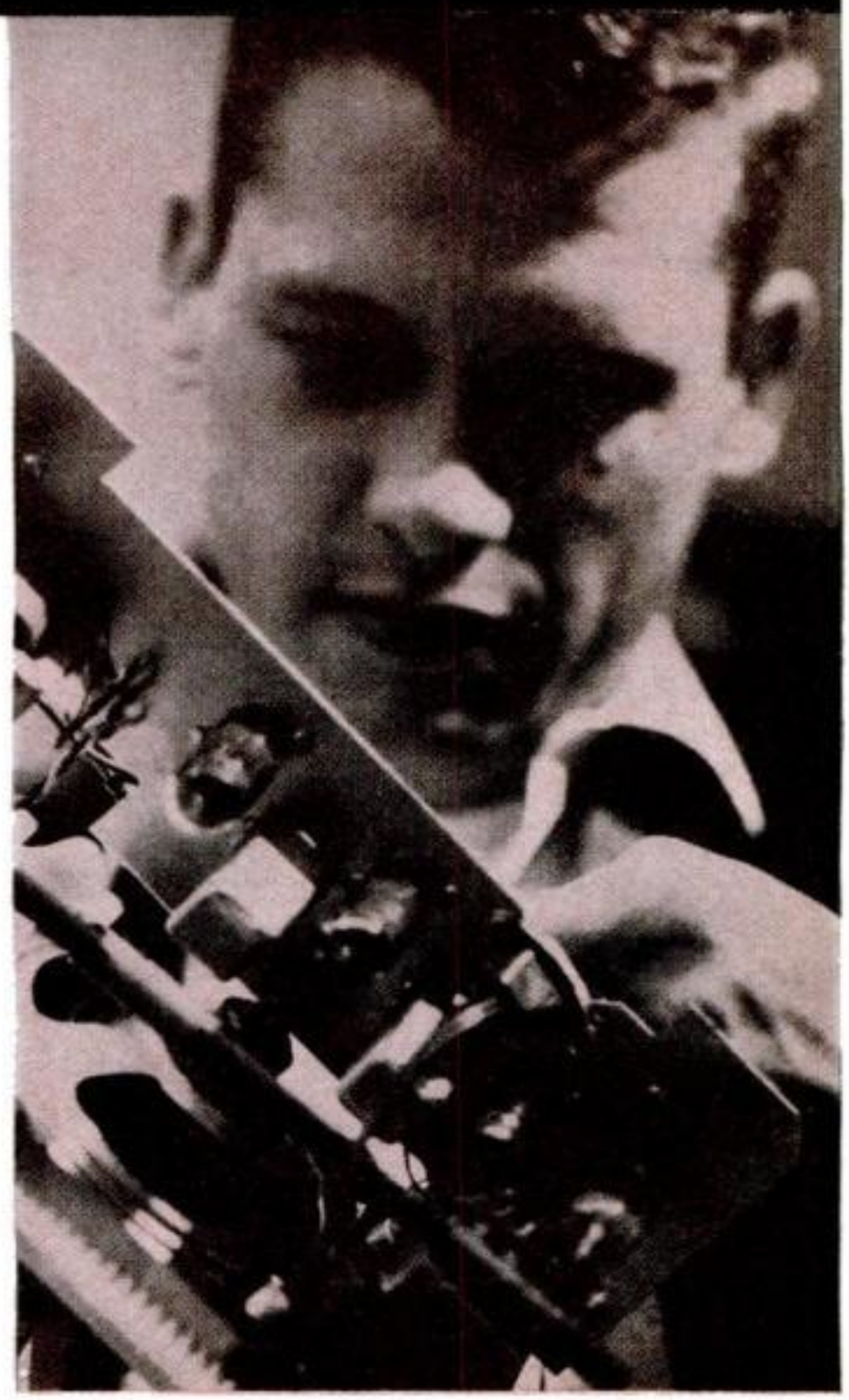

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F. W. COX, Hollywood, Calif., averaged $150 a month spare time while training, now has his own full time TV-Radio service business. ALLAN R. TOWNSEND, Topeka, Kan., is a missile officer at Atlas ICBM site, fixes radios and TV sets spare time. R. L. WOOD, Fargo, N. D., got his FCC license and is Master Control Engineer with KXIB-TV. J. J. JENKINS, San Diego, Calif., says his NRI training is priceless. He is Frequency Coordinator for the 11th Naval District.

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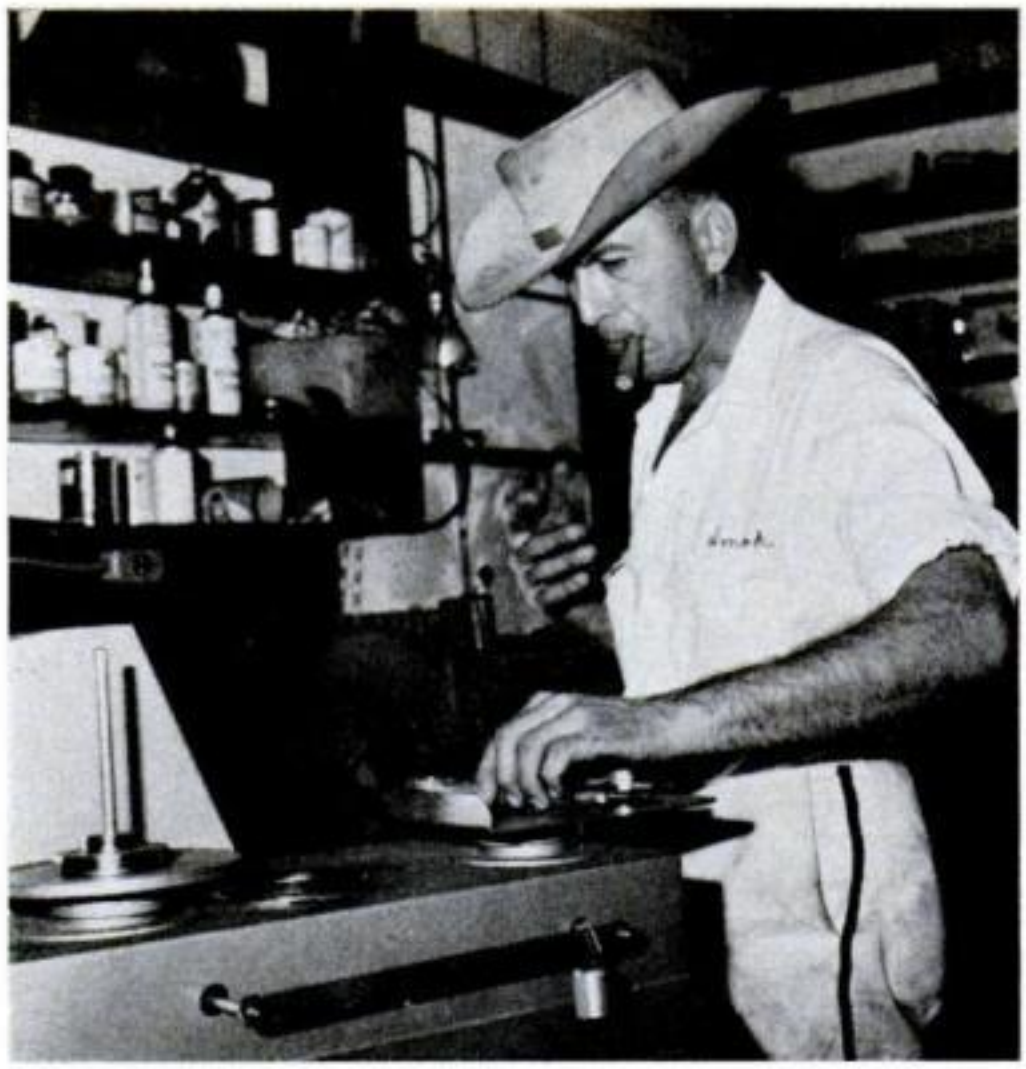

EACH month in POPULAR SCIENCE, Smokey Yunick will answer questions on automobiles—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Ask Smokey about it. You'll find the address at the end of the column.

"Why did Junior Johnson drive a Ford in the World 600 at Charlotte, N.C., after driving the fastest 100-mile race at Daytona earlier in the season with a Dodge?" —Claude Conter, Two Rivers, Wis.

He didn't feel confident in the Dodge; said it felt unstable. When it comes to changing their minds, I guess race drivers feel they have the same privilege as women —and I never tried to figure *them* out.

"I have just installed a full race cam in my '56 Ford 272, bored .040, with 312 manifold and Carter A.F.B. carb. How can I stop it from choking down when given full throttle at low speeds?"—Jimmy Packer, Longview, Tex.

That's like squeezing a man's throat, then wondering why he can't take a deep breath. The problem is low velocity in the manifold. You've got to be turning a lot of revs to get the mix through the carburetor fast enough. Either go on to multiple carburetion, or put the standard cam back in. You'll never get your car to perform equally well as both race and road machine.

"The Trophy 303-hp. engine in my '62 Pontiac gives me a lot of trouble from overheating. I've tried everything I know —flushing the engine, checking belt tension, checking the radiator, and installing a new thermostat. Nothing helped. Is this a characteristic of the car? What shall I do?"—Thomas C. Zawacki, NYC.

Overheating is not a common trouble with this car. Check for a head-gasket leak. Be sure the lower hose on the suction side of the pump isn't collapsing. Anything added up front, like certain types of air conditioners, could block the air flow through the radiator. Spark timing can cause overheating, if off. So can a pressure cap that won't hold 13 to 15 pounds.

"Is the best accleration gained by shifting at peak torque or peak horsepower?"— Charles Everett, Mobile, Ala.

Mechanics are divided on this one. My side takes torque.

"We have been unsuccessful in trying to get a smooth idle on our engine—325 hp. with 401-inch displacement and 10.25:1 compression. It's rough even at 900 r.p.m. Is it normal with this mill, or is the idle compensator in the 4-61 Rochester carb at fault?"—Gerald Benthin, Kalamazoo, Mich.

This sounds like a Buick engine, though you don't say so. In hot weather your carb could be at fault. Otherwise, you

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Smokey Yunick continued

had better check the ignition thoroughly, especially the distributor, with a Sun scope. A 10.25 engine with all the accessories and a four-barrel carb is as sensitive to tune-up as a fine fiddle. You have to keep after it. Be sure you have the exact plugs specified.

"How does Richard Petty open up those big leads at Daytona?"—Ralph Bone, Indianapolis.

He has some secret seasoning, which includes his eagle eye, lead foot, and steel nerves—and his dad's genius in tuning engines and balancing a chassis. I doubt that he'll let us know the other ingredients.

"My '55 Chevy wagon with V-8 engine has a two-barrel Rochester carb. The two front studs holding the carb get a tremendous amount of heat and almost burn away after 10,000 miles. What shall I do about it?"—George W. Meyer, Orange, Calif.

A crossover, from one side of the exhaust area to the other, was designed to warm that part of the carburetor for easy starting and better performance in cold weather. Check to see that the heat damper on the manifold's exhaust side is working and not trapping heat there. If that's okay, you can do one of two things: Pack the area with plumber's powdered asbestos dampened with water. Make sure none works loose to get into the exhaust valves. Or get a special intake-manifold gasket from a hot-rod shop. It has stainless-steel inserts to block the crossovers. The penalty in either method is poorer performance in cold weather until the engine is warm.

"Our '62 T-Bird pulls to the right when the brakes are applied—ever since we had new linings installed. The shop told us that one of the plumbing lines could be collapsed inside, so the lines were replaced. The drums have been turned and the linings refaced, but the trouble goes on. Can you help?"—Robert E. Grahn, Evansville, Ind.

It may be that one wheel is getting more fluid than the opposite one. A prime cause of your trouble is a wheel-cylinder cup sticking. Check the cylinders all around because even a rear-wheel pull will sometimes give the effect of trouble in front. Next, check contact of the shoes to the

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Shown below—the neatest squelch of all, the Chevelle Malibu SS Coupe

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Smokey Yunick continued

drums. Sometimes when drums are turned, their diameters vary, causing unequal braking. Check to see that the linings are properly shimmed. Another possibility could be one weak front coil spring. As the brakes are applied, the car could dive to the weak side, causing pull.

"There is a half-inch play in all directions in the steering of my '55 Chevy. Is there any way that I can correct this without buying a new steering column?"—Bob Foltz, York, Pa.

Yes, it's easy. Your steering gear is both adjustable and repairable. Be sure to check all your linkage and actual suspension points while you're at it.

"My '62 Imperial uses a quart of oil every 250 miles. I've always used Quaker State and changed regularly. At 26,000, the dealer put in new rings. They finally stopped the oil from leaking around the valve covers, but consumption has not stopped, and is apparent through the exhaust."—Charles Diegel, Lubbock, Tex.

You don't mention whether break-in oil was used with the new rings. The reason for break-in oil is that some of the new regular oils do such a good job of lubricating cylinder walls that new rings can't wear in against them. Other sources of oil loss to check: crankcase vents, fuel-pump diaphragm, and valve stems, both intake and exhaust. Check the camshaft for timing. If nothing shows up, I'm afraid you're in for another ring job—and be sure to use break-in oil.

"In a recent PS, you advised sticking to one brand of engine oil. Does this hold true for differential and transmission lubricant?"—O. L. Hinger, El Paso, Tex.

Absolutely—if it is the recommended type and viscosity for the particular car. The different lubricant companies use various chemicals that are not compatible. Even different grades of lube from the same manufacturer won't mix well.

Got a question on autos? Send it to:
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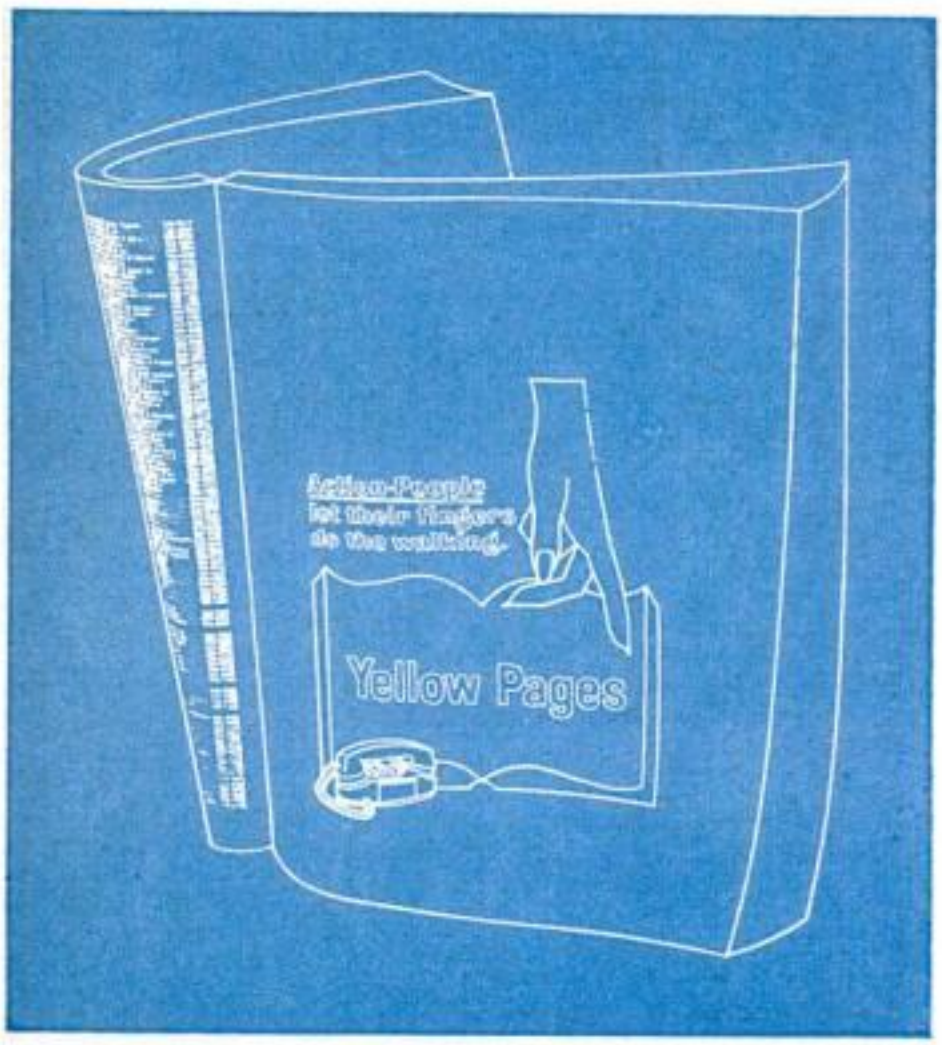

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Getting Ahead

A monthly column to help you prepare yourself for a better job

By Dr. Lewis R. Fibel

FOR every 100 engineers and scientists, roughly 38 technicians are needed, says the Engineering Manpower Commission. Last year, about a third of all new technicians were upgraded from within, but from here on out, the majority hired will be from technical or trade schools.

The largest expected growth rates for technicians: in food products, construction, stone, clay, and glass industries. Electronics, aerospace, and research should have higher-than-average growth.

"Where in the West can I study to be a mapmaker?"—F.V.N., Riverside, N.J.

Mapmaking is done by cartographers. The minimum educational requirement is a bachelor's degree with a major in geography.

A few Western colleges (from more than 150 in the field): U. of Calif. at Berkeley; U. of Colorado at Boulder; U. of Idaho at Moscow; Ore. State U. at Corvallis; and U. of Wyoming at Laramie.

Cartographers are employed by state and federal governments, colleges and universities, and mapmakers like Rand McNally and the National Geographic Society.

"What are the career and training opportunities for an electronics technician?" —G.R., Sioux Falls, S.D.

Electronics technology includes radio, radar, sonar, telemetering, television, telephony; industrial and medical measuring, recording, indicating, and controlling devices; navigation equipment; missile and spacecraft guidance and control instruments; computers; and other equipment using vacuum tubes and semiconductor circuits.

The technicians work with scientists and engineers, preparing layouts, developing and testing electronic circuits. They also

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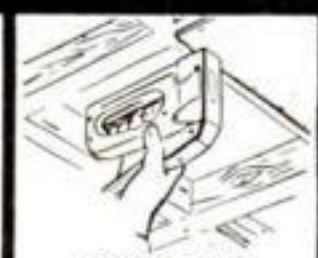
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Getting Ahead continued

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Technical institutes, junior and community colleges, some four-year colleges, and some technical high schools teach electronics. On-the-job training is often possible, plus study by correspondence.

"What degree do I need to design hydraulic systems?"—S.R.B., Clearwater, Fla.

A bachelor's degree in engineering. The design of such systems may be handled by mechanical, civil, sanitary, or petroleum engineers, depending upon application.

Although most engineers eventually specialize, the basic knowledge required for all branches makes it relatively easy to shift from field to field. I'd say, enter a convenient engineering school (U. of Alabama, Georgia, Florida, or Miami; Auburn U.; Georgia Tech) and be concerned about your specialty only at a later date.

"Is it true some employers won't accept high-school diplomas from correspondence schools?"—D.L.M., N. Judson, Ind.

An employer can set up any job-entry requirement he pleases—even one based on personal prejudice. There may be some who would discriminate against a home-study diploma; many more would not.

Most states offer the opportunity to secure a high-school-equivalency diploma by examination. Your local high school should be able to acquaint you with regulations in your state. Home-study courses would be excellent preparation for such exams.

"I'm interested in podiatry. What are the educational requirements? Schools?"—E.J.B., Ann Arbor, Mich.

Most colleges of podiatry require two prior years of pre-med for entrance. All states require a license to practice. To qualify, an applicant must be a college of podiatry graduate and, in your state (and N.J. and R.I.), serve an internship.

Colleges: College of Podiatry (53 E. 124th St., NYC); Chicago College of Chiropodic & Podiatric Surgery (1427 W. Monroe St.); Illinois College of Chiropodic & Foot Surgery (1327 N. Clark St., Chicago); Ohio College of Chiropody (2057 Cornell Rd., Cleveland); and the Calif. College of

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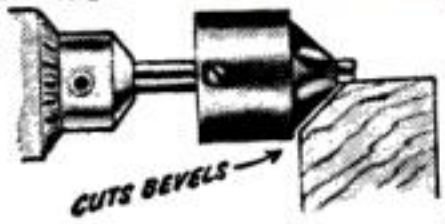

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New Push-Button Spray Repels Assailants. Smaller than a pen. • Safe • Easy To Use.

A new weapon now protects people from attack. Tiny aerosol can "fires" by pressing button. Spray strikes nose and eyes of the attacker and sends him screaming for help. Yet, the damage is only temporary. No license. No regulations against use. The perfect weapon for pocket, purse, car, nightstand. Ideal against dogs and other animals too. Not sold to minors. Only **$1.98** plus 25c pp & hdlg. **No Permanent injury.**

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Tachometer. Precision engineered. GUARANTEED. Handsome multi-purpose watch for sportsmen, athletes . . . checks distances, speed, recording time, races, output. Swiss movement, parts gld. 1 year. Gold on top, stainless back, shock resistant, leather strap, radium hands, precision movement. Includes 45-minute and 6-hour registers. Great gift. **$9.95** ppd

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Getting Ahead continued

Podiatry (1770 Eddy St., San Francisco).

Career information can be obtained from the American Podiatry Assn., 3301 16th St. N.W., Washington, D.C. 20010.

"How does one become a master mechanic?"—C.B., Hudson, N.H.

There are more than 2¾ million mechanics, in perhaps 200 different occupations. Auto mechanics number over 700,000. Others (hearing-aid repairmen, X-ray servicemen, etc.) number only a few hundred. Maintenance electricians, appliance servicemen, telephone installers/repairmen, airplane mechanics, radio/TV servicemen, and machinery repairmen form large groups.

Advancement to "master mechanic" (often foreman, as well) is gained through experience, which brings greater skills.

"I'd like information on landscape architecture."—D.C., Carmel, Ind.

Such architects landscape parks, gardens, scenic roads, housing projects, factory grounds, campuses, country clubs, and homes. They may plan an entire site—grading, installation of retaining walls, drainage, etc.—or supervise the work.

Training (with a bachelor's degree) is offered in about 20 colleges. A list of 16 accredited by the American Society of Landscape Architects, and data on the profession, can be obtained from the Society at 2000 K St. N.W., Washington, D.C.

"Where can I get training in firefighting?"—P.A.R., Biddeford, Me.

A few junior colleges offer two-year courses in "fire science," including: East Los Angeles (Calif.) College, Palomar College (San Marcos, Calif.), Vincennes (Vincennes, Ind.) University.

Among trade schools are the State Technical School (Hartford, Conn.) and Cunney's Civil Service School (Marblehead, Mass.).

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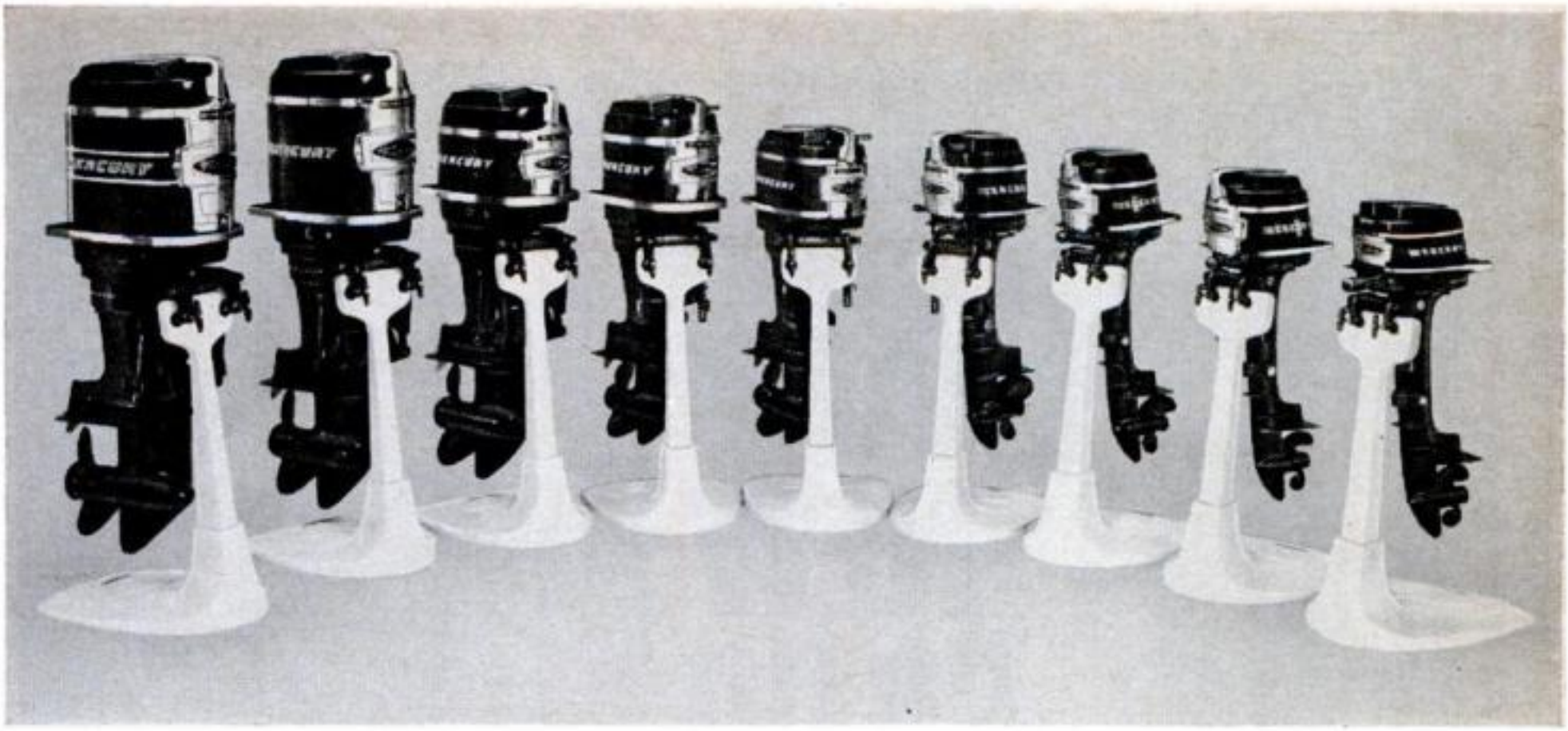
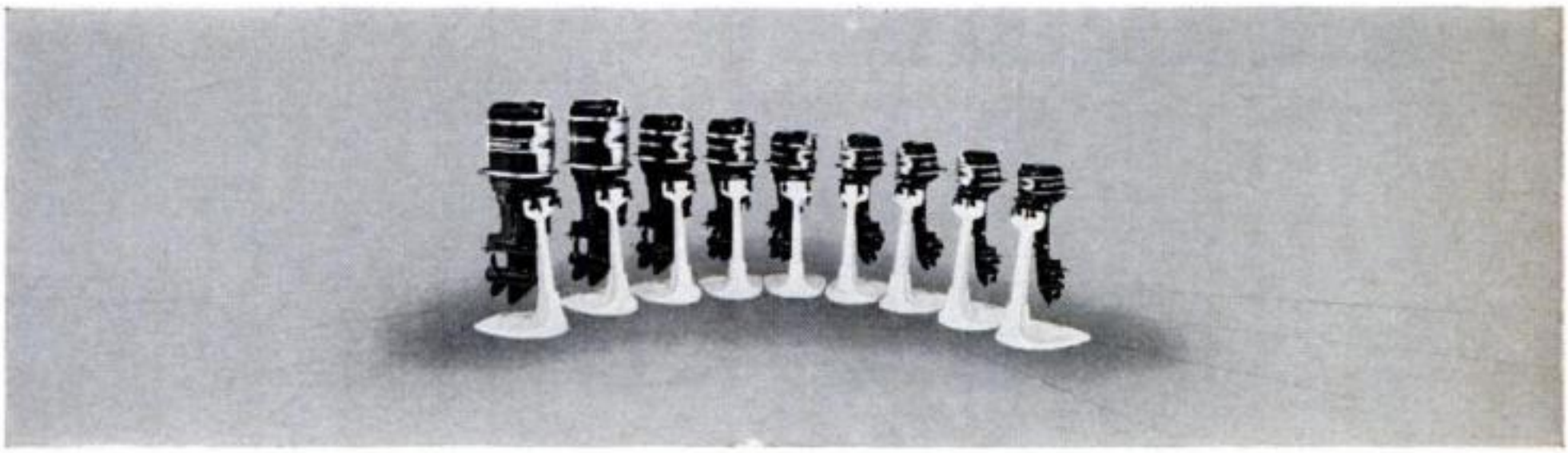


1965 Mercs: Here's how they look



Here's how they sound

These are the 1965 Mercs . . . the most complete selection of outboard power ever offered. In addition to new power and new design, Mercury now brings a *new quiet sound* to outboarding.

The 1965 four- and six-cylinder Mercs are actually 50% quieter. This was accomplished by using an entirely new principle for engine silencing. The cowling is now isolated from the powerhead by large, soft-rubber mounts. This fireproof cowling has become a sound capsule that effectively seals in normal working noises of the engine. Connections for control cables are inside the capsule and openings are sealed by neoprene closures. Exhaust noises are silenced by a wall of water. The engine's discharged cooling water is used to surround Mercury's new internal exhaust pipe and prevent noise from escaping through the walls of the drive shaft housing. Unlike ordinary outboards, which pay for noise reduction by *sacrificing* power, Merc's new silencing system actually *boosts* power to the prop.

For 1965 there's a new 90 hp Merc that surpasses any other 90 in power at the propeller and fuel economy. All of the new Mercs are restyled and the higher horsepower models have a lower profile.

There are nine new Mercs from which to choose: 100, 90, 65, 50, 35, 20, 9.8, 6 or 3.9 horsepower. Mercury again brings you the *highest* horsepower, the *widest selection* of power and the *greatest* fuel economy. You get more RUN for your money with Mercury.

MERCURY

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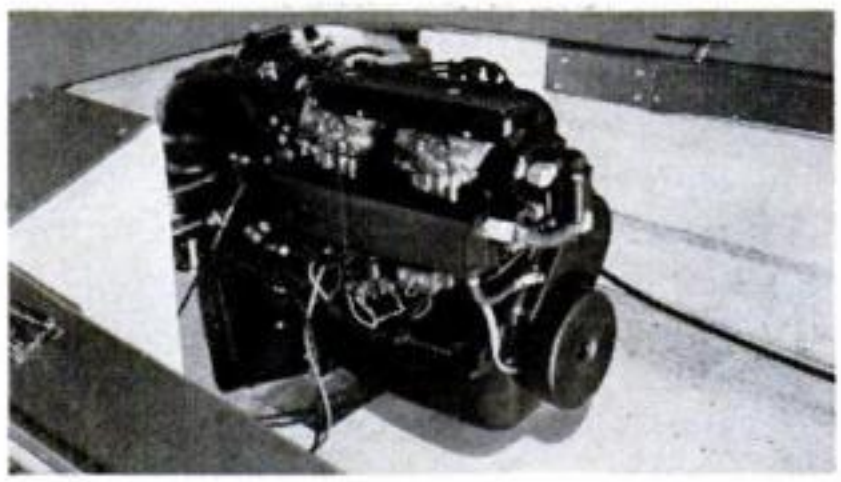
Now...4-cycle power, performance and fuel economy for boats

BRAND NEW 60 hp MERCRUISER STERN DRIVE

THE ENGINE: Up until now, there were three practical ways to power a small boat: an outboard engine, oars, or a sail. Inboard engines took too much room in the middle of the boat.

Now, a true "compact," MerCruiser 60 Stern Drive, makes it possible for you to enjoy the convenience, fuel economy and low maintenance of a 4-cycle inboard *without losing room in the boat.* Why? Because MerCruiser's compact 60 hp engine is mounted directly to the transom where it takes no more room than the motor well for an outboard.

Four-cycle marine engines have long been a favorite of many boaters and MerCruiser 60 is the newest design in light, compact 4-cycle power. It has a direct-drive alternator . . . no brushes to wear, no contacts to arc, and no regulator required. We eliminated all belts. Its direct-drive water pump is "outboard" and equipped with a telltale so you can tell at a glance that it's working properly. The ultimate in vibration isolation, new Dyna-Focal aircraft-type



mounts mean a new definition of silence . . . eliminate mounting rails and engine bed! MerCruiser's husky new engine and new drive unit counterbalance each other on the transom. Simple to install. All steering and control mechanisms are inside the boat.

MerCruiser 60 uses conventional 4-cycle fuel and oil. Fuel consumption is dependent on boat and load conditions but our test boats with MerCruiser 60 have been running 4½ to 5 gallons per hour at full throttle . . . that's from 25 to 36 miles an hour on 14 to 18 ft. boats. At cruising speed, the fuel consumption is as low as 3 gallons per hour.

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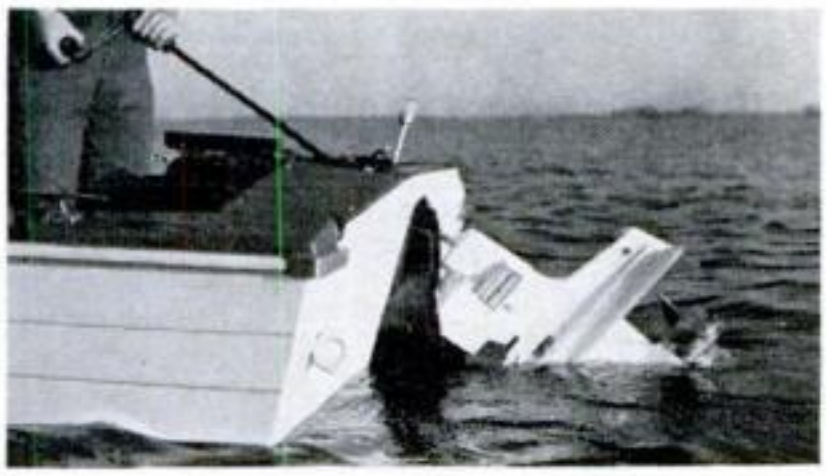
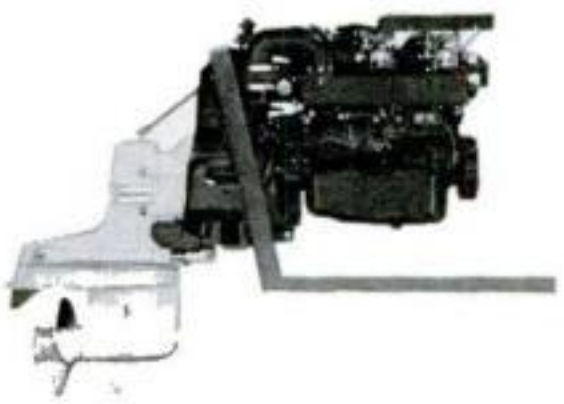
as small as 14 ft.





THE DRIVE UNIT: Much of the new MerCruiser 60's performance comes from the inherent advantages of a stern drive: propeller thrust parallel to the plane of motion; adjustable tilt angles; and no angled prop shaft, strut, or rudder to cause drag. Much also is due to MerCruiser's smooth, one-piece castings, adequate gear reduction ratios, and exclusive Jet-Prop exhaust. The Jet-Prop reduces drag, improves engine breathing and buries noise and fumes far behind the boat. The MerCruiser 60 drive unit has an exclusive cable tilt mechanism that allows you to adjust the drive angle for shallow water running or to raise the unit out of the water, entirely, for inspection or beaching.

Why don't you drop by your MerCruiser dealer's today, and take a stern attitude with him. He'll show you why more MerCruisers are sold than all other stern drives combined . . . 60, 110, 120, 150, 190, 225, and 310 hp gasoline; 60 hp diesel.

MERCRUISER

STERN DRIVE POWER PACKAGES

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Projects illustrations up to 3" x 3½" and enlarges them to 35" x 30" if screen is 6½ ft. from projector; larger pictures if screen is further away. No film or negatives needed. Projects charts, diagrams, pictures, photos, lettering in full color or black-and-white. Operates on 115 volt, A.C. current. 6-ft. extension cord and plug included. Operates on 60-watt bulb, not included. Size 12" x 8" x 4½" wide. Weight 1 lb., 2 oz. Plastic case with built-in handle.
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Same unit as above, but provides endless additional projects with everchanging kaleidoscope patterns.
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ACTUAL MINIATURE VERSION OF GIANT ELECTRONIC BRAINS

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Great idea! Fascinating fun and sometimes tremendously profitable! Tie a line to our 5-lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along the bottom—your "treasure" haul can be outboard motors, anchors, fishing tackle, all kinds of metal valuables. 5-lb. Magnet is war surplus—Alnico V Type—Gov't. Cost, $50. Lifts over 150 lbs. on land—much greater weights under water. Order now and try this new sport.
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Big savings! Brand new! Crystal-clear viewing—7 power. Every optical element is coated. An excellent night glass—the size recommended for satellite viewing. Individual eye focus. Exit pupil 7 mm. Approx. field at 1,000 yds. is 376 ft. Carrying case included. American 7 x 50's normally cost $274.50. Our war surplus price saves you real money.
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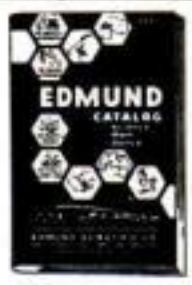

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Science Newsfront

LATEST DEVELOPMENTS IN SCIENCE, BY **WALLACE CLOUD**, PS SCIENCE EDITOR FEBRUARY, 1965

Stone-Age Men Go Modern

Islanders fight their own war on poverty, says Margaret Mead

Snailpower Measured In Battle Against A Tropical Disease

Why did Drs. William R. Jobin and Arthur T. Ippen of M.I.T.'s civil-engineering department put nylon harnesses on Puerto Rican fresh-water snails to measure their pulling power? (Which turned out to be 1/250,000,000 horsepower for the average healthy ¾-inch snail.)

Because snails multiplying in badly designed drainage and irrigation canals are carriers of schistosomiasis, a spreading tropical disease. Jobin and Ippen wanted to find out how fast water in the canals would have to flow in order to keep snails from maintaining a foothold.

That figure turned out to be about 13 inches per second in the dragging boundary layer along the sides and bottom of a canal (meaning a flow of two to three feet per second in midstream).

Dr. Mead revisits Manus Island village she has studied since 1928.

The stone-age people of New Guinea are jumping straight into twentieth-century civilization, says Dr. Margaret Mead, the anthropologist. We talked with her on her return from a field trip to the village of Peri, on Manus in the Admiralty Islands—her third visit in a 36-year period.

When she first lived with the bushy-haired Manus people in 1928, their villages were built on stilts over the water; they were riddled with taboos and bitter family feuds, and they had just been pacified after a long history of tribal warfare. Today they have moved ashore and live in planned towns, wear occidental clothing, have schools, hospitals, consumers' co-ops, and elected government, and like to travel by plane whenever they can afford to.

Dr. Mead explained how it happened: They did it themselves, following their large-scale contact with civilization in World War II.

Impressed by GIs

Over a million American GIs passed through Manus, bringing jeeps, trucks, construction machinery, field hospitals, and food, and building bridges, camps, and docks. "The Manus people say they learned from the Americans not to be materialistic," said Dr. Mead. They saw how no expense was spared in the saving of human lives, and also experienced the GIs' generosity with Uncle Sam's property—but they understood that this was possible only because we had plenty to give.

Continued on Page 30

Heatless building stays warm

There's no heating system in the new, 94,500-square-foot administration building of Electronic Associates in West Long Branch, N.J., but people inside are comfortable even when the temperature outdoors drops to 15 degrees. Waste heat, from people, electrical equipment, and the lighting system, is recovered and circulated through the air-conditioning system. Heating engineers say the method can be used in many industrial and office buildings, but not for homes (not enough waste).

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Science Newsfront

Continued

When the war ended and the GIs went home, the primitive people wanted to move into the modern world. Some had an understanding of how to begin, but they had to fight against "cargo cults" that sprang up all over the South Pacific.

These cults are based on a belief that the ships and planes will come again, bringing the good things that make life easy. Self-appointed prophets predict that the coming of the cargo is imminent, and convince the people of a village to destroy everything they have, kill their pigs, and feast until the cargo arrives. When it doesn't come, rituals combat whatever is "stopping the cargo."

But some local leaders, with little or no formal education, developed rational ways of imitating the Americans and Europeans they had observed. Gradually, villages in many parts of New Guinea began to organize along democratic lines, setting up local councils, starting their own schools, and collecting taxes. The Australian government, which administers New Guinea, then started a "peace corps," placing gifted teachers in the villages.

The transformation can serve as a lesson for the U.S. war on poverty, Dr. Mead said. "It shows how fast people can move—when the ceiling is taken off a society." The people of Manus wanted to change completely, and they have the feeling that anything they want is possible. "They get the same kind of lift as American children in those parts of the country where they are taught that any boy can become President," she said.

Pilot lowers the boom on a desert test village

An "accidental" sonic boom of high intensity recently smashed part of a test village built by the Federal Aviation Agency in the New Mexico desert, when an Air Force F-104 jet fighter plane broke the sound barrier on a low-level pass.

The FAA is conducting a second series of sonic-boom tests to see how flights of the proposed 2,000-m.p.h. supersonic airliner might affect buildings and people on the ground. A series over Oklahoma City produced inadequate data, although more than 4,000 damage claims were filed by citizens there.

In the New Mexico incident, the shock waves smashed a greenhouse and shattered

Continued on page 32

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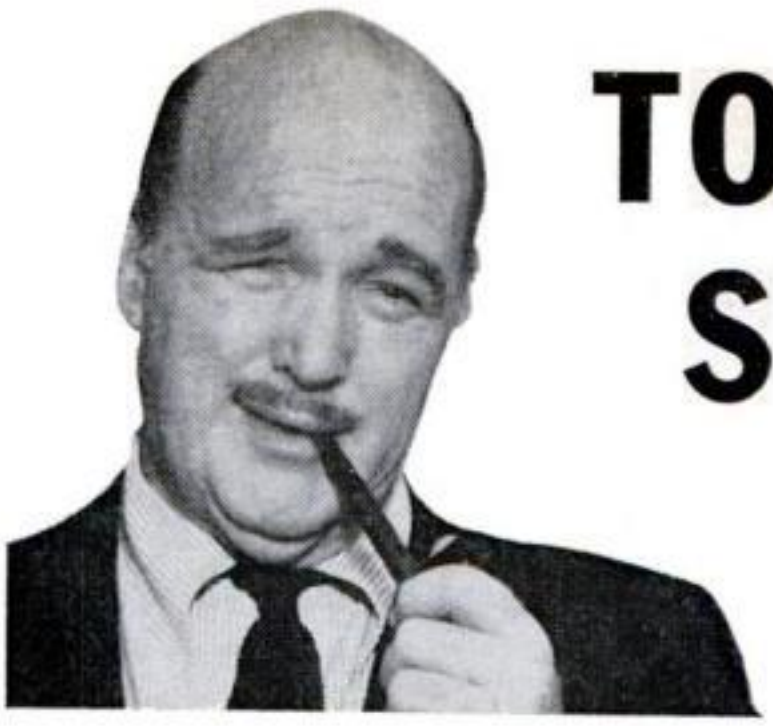

TOM McCAHILL SOUNDS OFF ON JOBS

The trouble with too many people today is they want to start "on the job" as Executive Vice President—and work their way up.

This is fine. But, with the exception of banks, there just aren't enough VP jobs to go around. So the years tick away in a dead end job, looking for that pot of gold that's already dried up. And the worst part is—there's no middleman profit after the bills are paid every month.

If there's any field today where the average guy can make real money, it's the service business. If you can provide a service that people need, do the job right and show some old-fashioned honesty, you've got it made.

For instance.

This is the age of automation. You don't rub sticks together any more to fry bacon. Just toss it in a time and temperature controlled frypan and read the paper. Some of the kids nowadays wouldn't know how to wash a dish. They stack 'em in the dishwasher and knee the door shut. Most people think a scrub board is a thing for making music. They watch TV while two cents worth of electricity washes, rinses, spins and dries the duds.

A house just isn't a home unless it's loaded with automatic gadgets. And it's pretty easy living until something breaks down. Here's a spot where the guy who can fix today's electrical appliances can make himself a mint of money.

How does anybody get into this field? It's easier than you think. The Appliance Division of the National Radio Institute in Washington, D. C., has a unique and downright interesting home-study course that shows how to fix almost anything the way the pros do it. It covers appliances large and small, air conditioning, refrigeration, and they even toss in small gasoline engine repair for good measure—and earning power.

NRI is one of the biggest and best home-study schools in the country today. Their reputation is tops. After 50 years in the teaching business, they make learning as close to being fun as anything you've tackled. Best of all, this kind of training costs a lot less than you think.

If you're looking for a job with a solid future or want to pick up some cash in your spare time, take a look at the opportunities in this appliance repair business. NRI sends you a free book that tells all about it (and no salesman banging on the door).

The appliance field might not make you an Executive Vice President. But you could wind up with a bankroll as big as most VP's I've met—and as a bonus—no ulcers.

Tom McCahill

TOM McCAHILL

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Science Newsfront

Continued

a storefront, and plaster in the 17 buildings was heavily damaged. Test engineers feared they would have to rebuild the village.

Ironically, none of the 110 recording instruments in the site was turned on at the time.

The havoc was evidently the result of miscalculation by the jet pilot, who was not expected to exceed the speed of sound on that pass. The unpredictable nature of shock waves is one reason why the projected supersonic airliner is such a big headache in aviation circles.

Who murdered Napoleon? —scientists name a suspect

A team of British and Swedish scientists plans to ask the French government to dig up Napoleon's body for examination, since recent tests on locks of his hair have yielded more evidence that he was murdered by slow poisoning with arsenic.

They have even named the alleged murderer: Count Montholon, Napoleon's constant companion in exile on the island of St. Helena. Montholon was left two million francs in Napoleon's will.

The tests were made by neutron-activation analysis—bombarding hairs with neutrons in atomic reactors. This makes the atoms in the sample radioactive. From the types of radioactivity given off, arsenic was identified. The analytical method is so sensitive that the progress of the poisoning over many months could be traced.

The group of researchers includes Dr. Hamilton Smith, a physicist at Glasgow University, and Drs. Sven Forshufvud and Anders Wassen of Sweden. Three years ago Dr. Forshufvud published a book advancing a poisoning theory of Napoleon's death, after earlier neutron-activation tests had revealed arsenic in his hair.

Vampires are sick, psychiatrists assert

Human vampires do exist, according to two Denver psychiatrists, Drs. Richard L. Vanden Bergh and John F. Kelly. Rather than being "the undead," the vampires are mentally ill. In the *Archives of General Psychiatry*, the two psychiatrists reported rare cases in which vampirism, or sucking another person's blood, was part of a pattern of homosexual behavior. ■ ■

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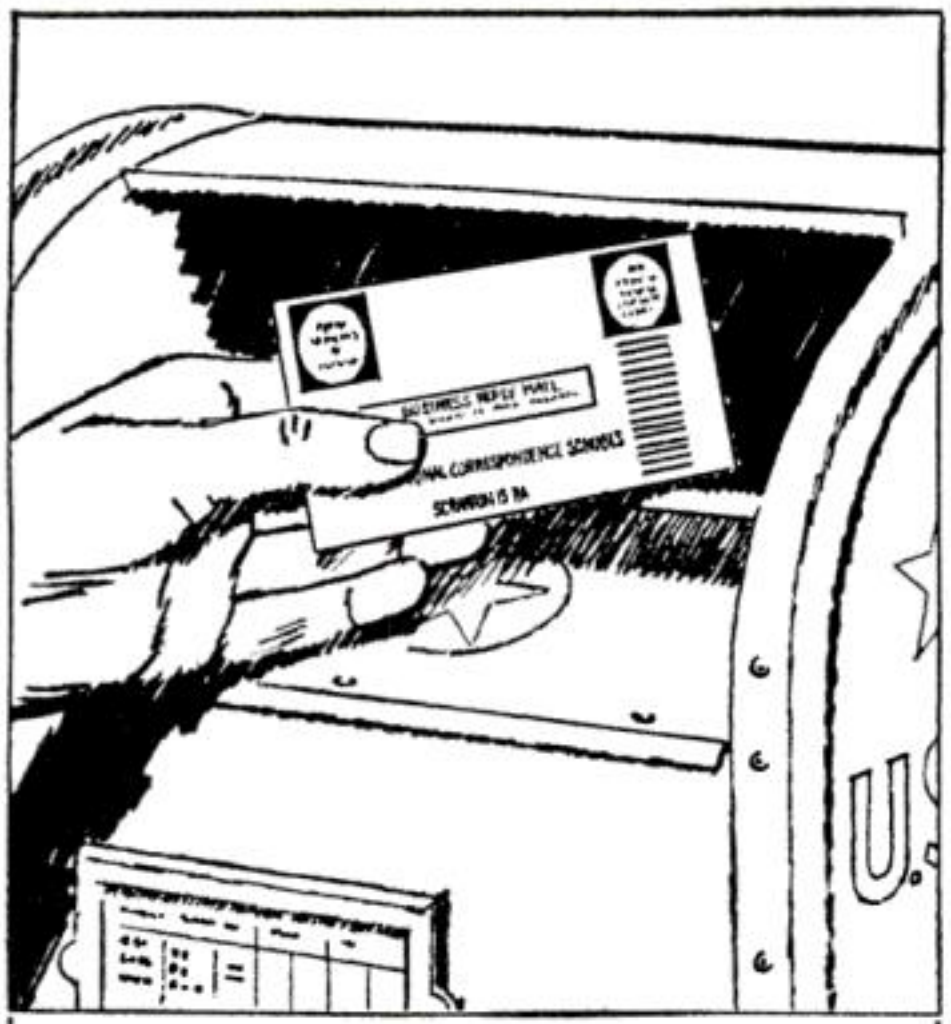

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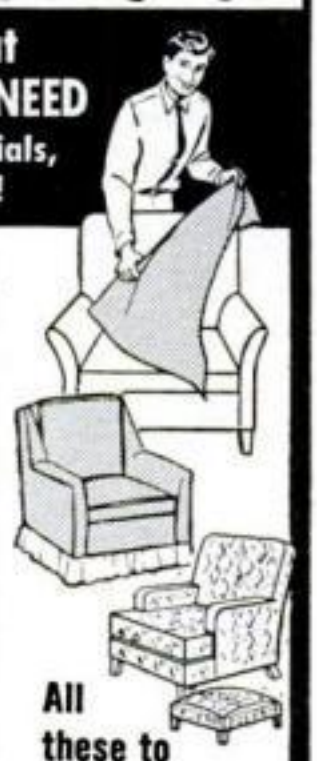

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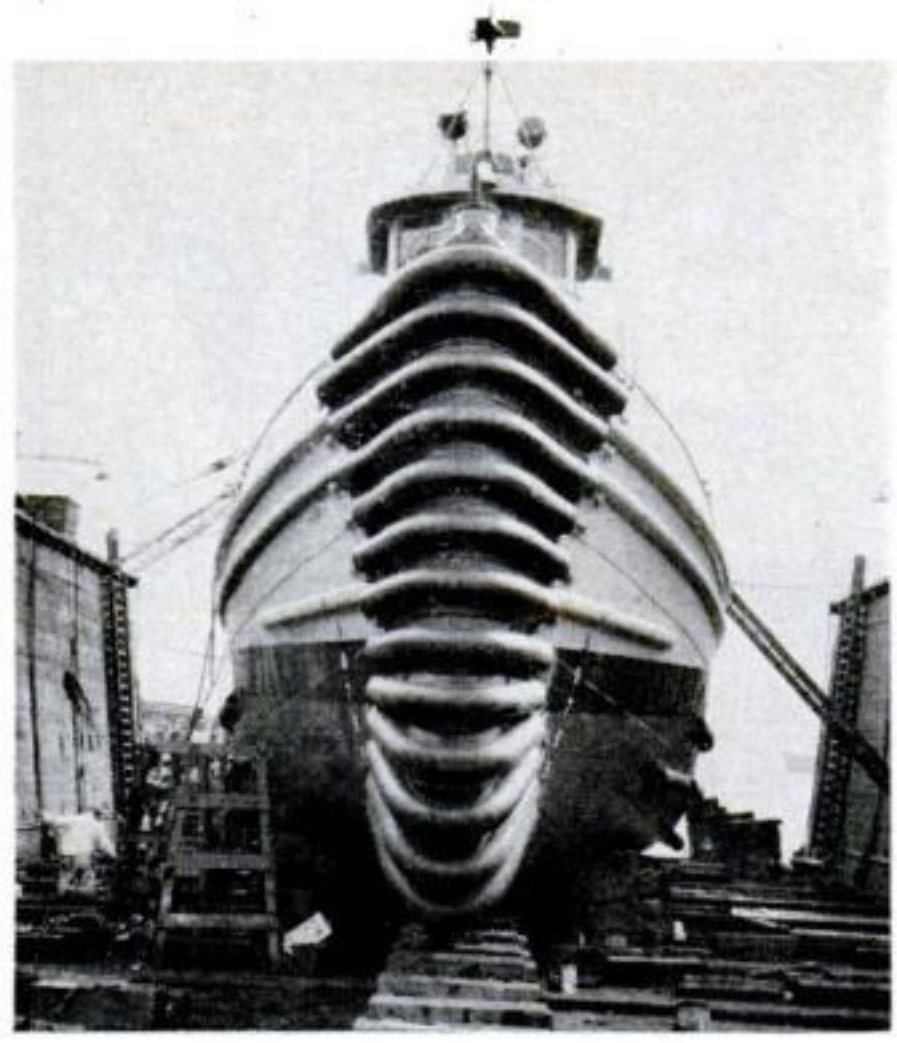

Keel-deep fenders protect tug

While servicing a submarine recently, a Navy tug was bumped and seriously damaged below her waterline. Now the tug (above) has added protection: rubber fenders that had guarded the bow above water have been extended all the way down to the keel. In addition, two rows of fenders were installed on the sides just above the keel.

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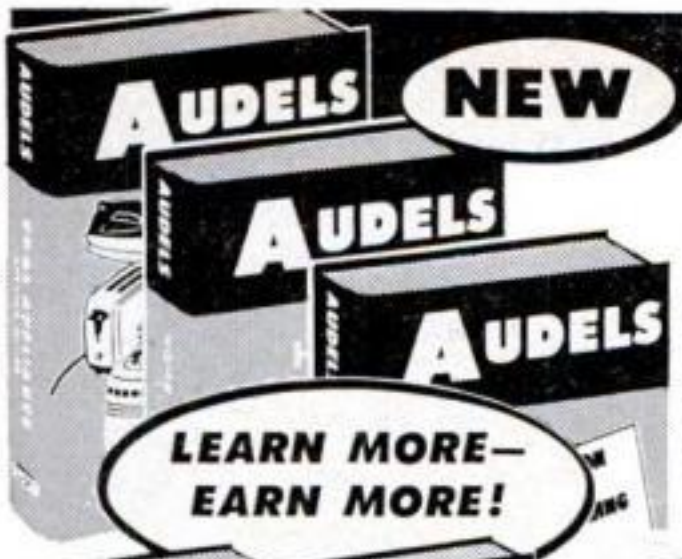

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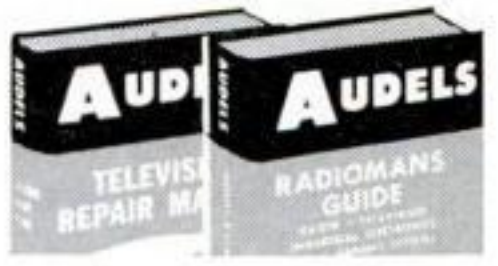

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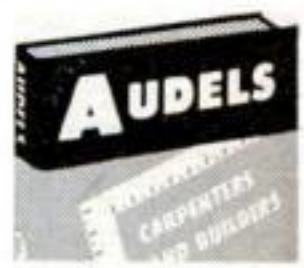

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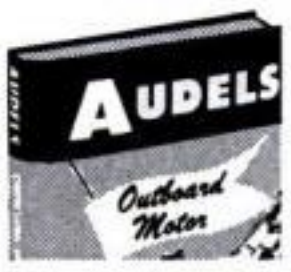

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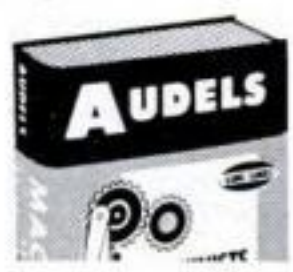

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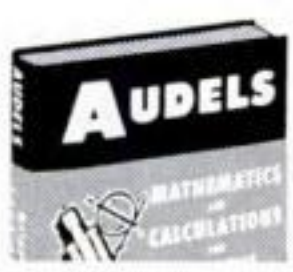

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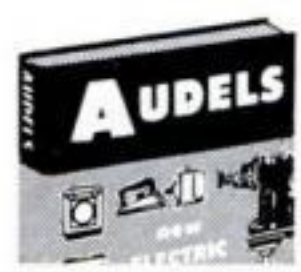

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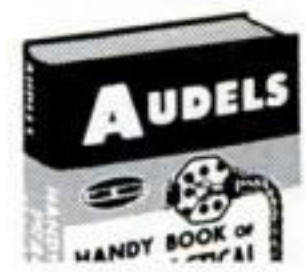

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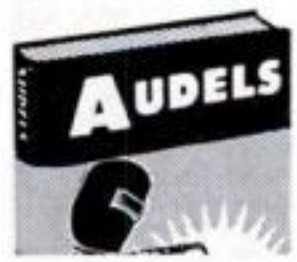

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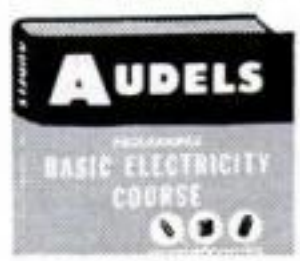

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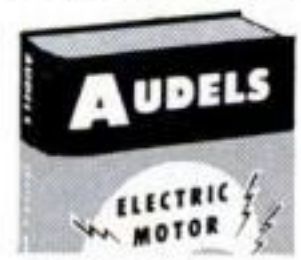

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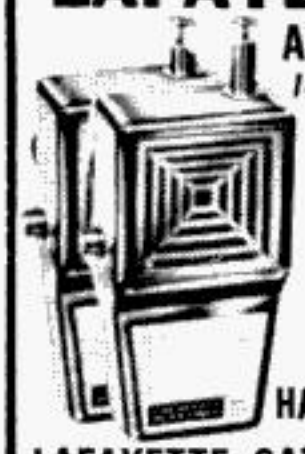

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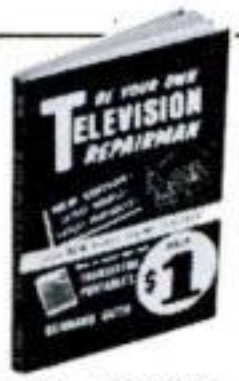

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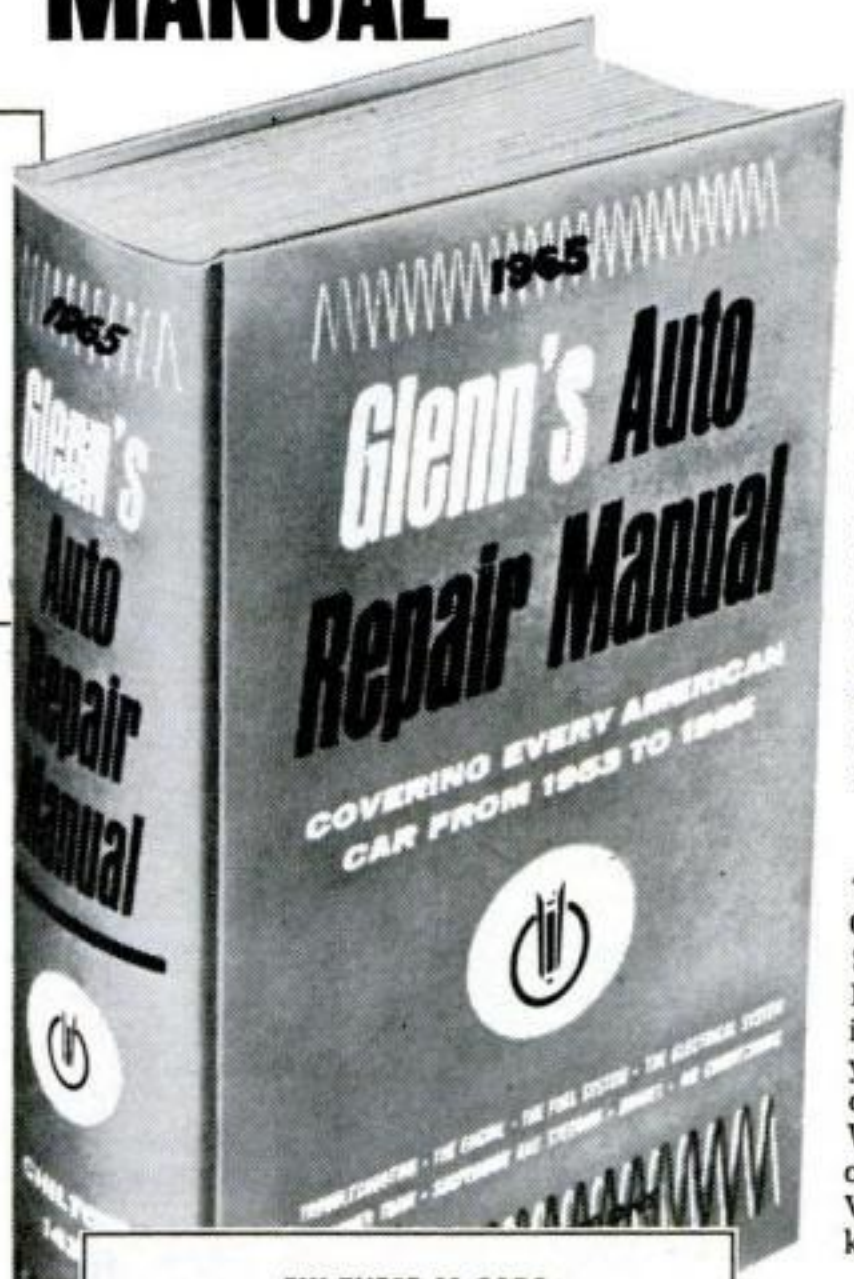

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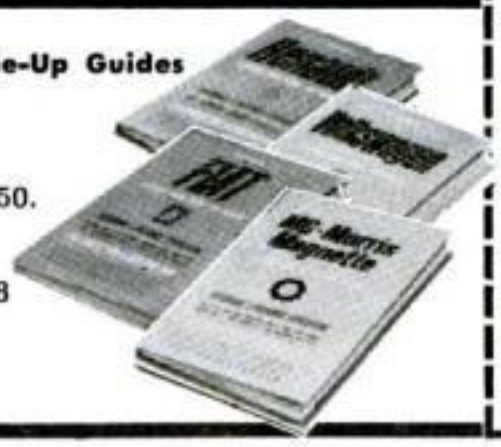

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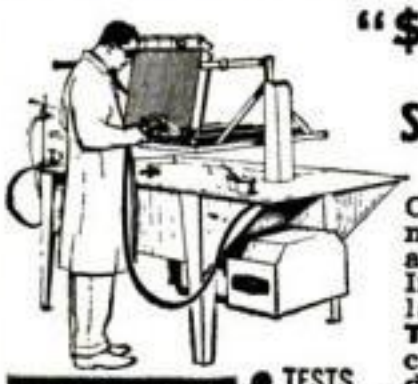

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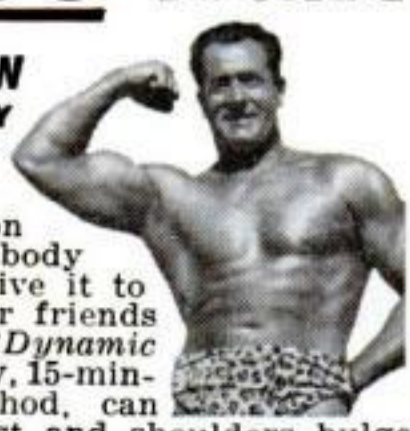

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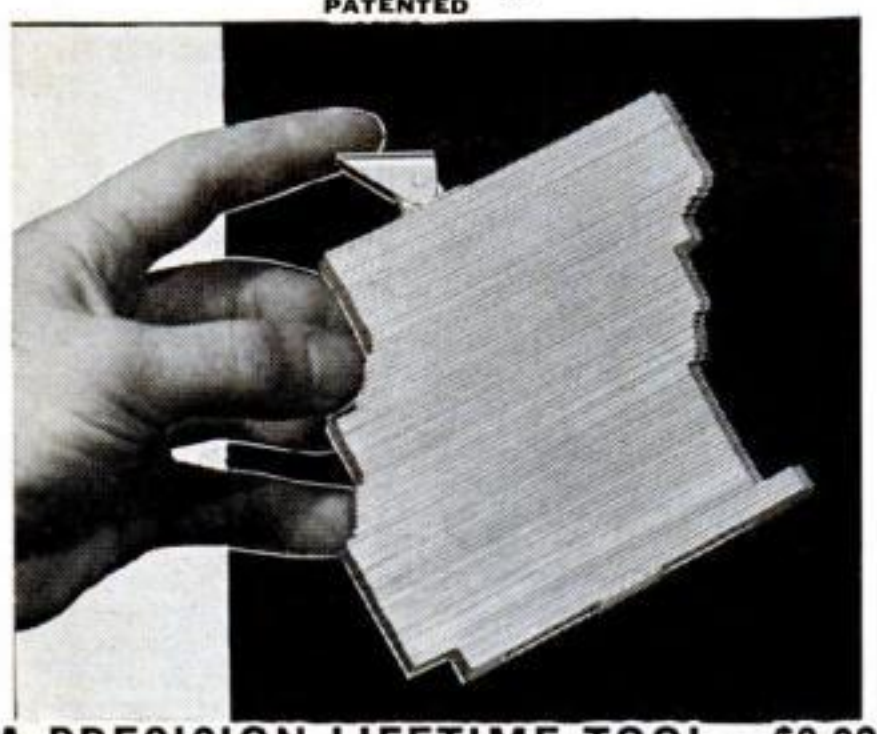

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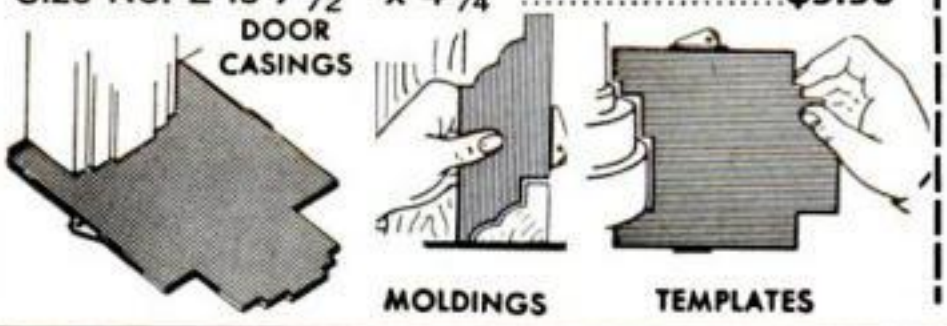

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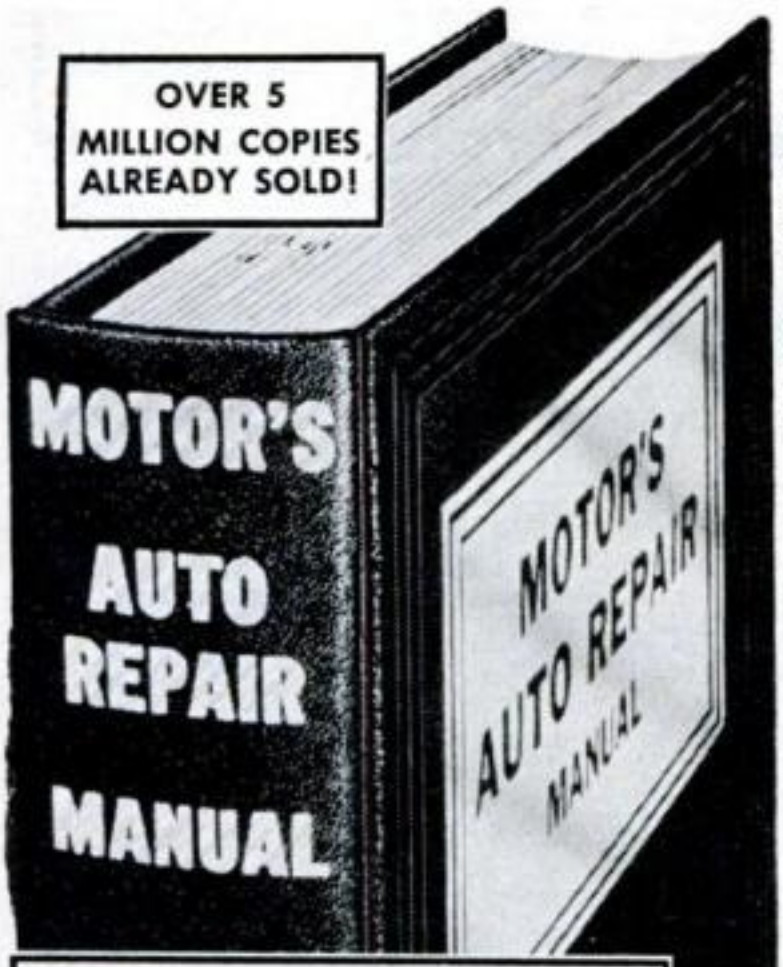

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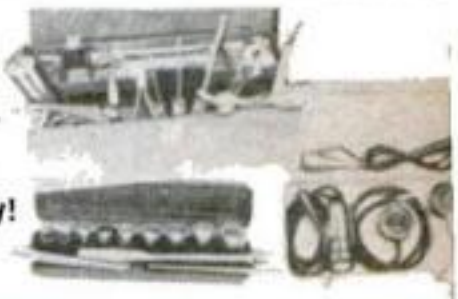

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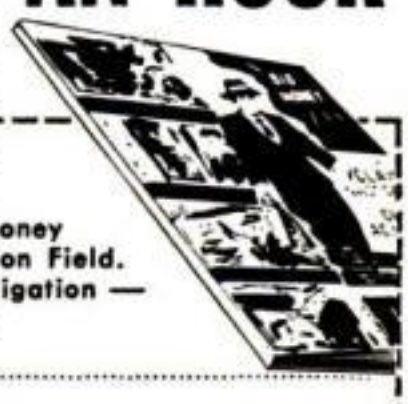

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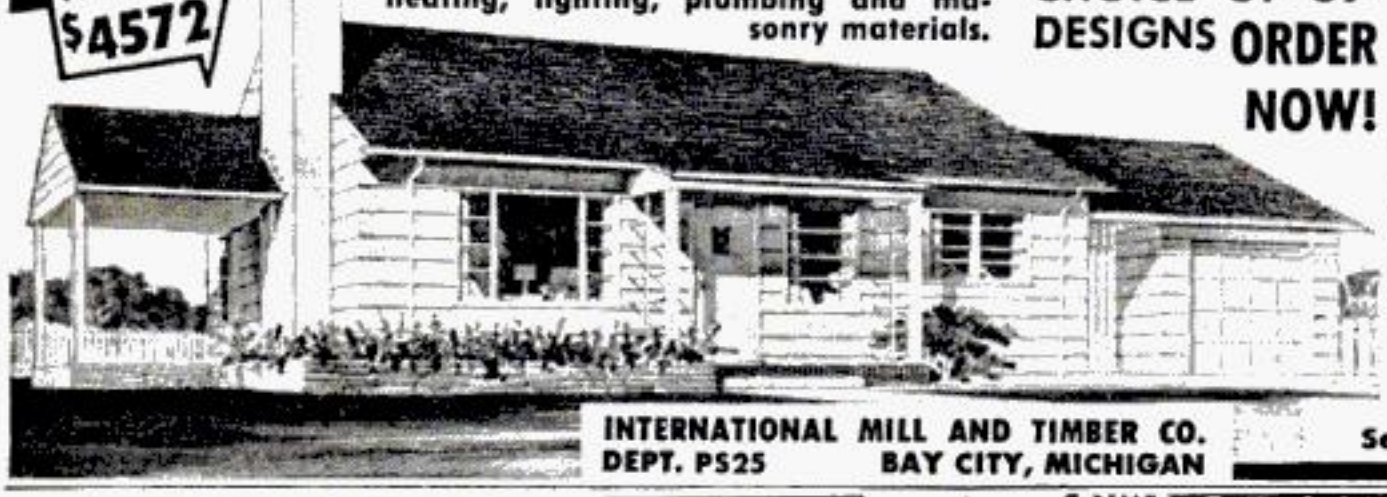

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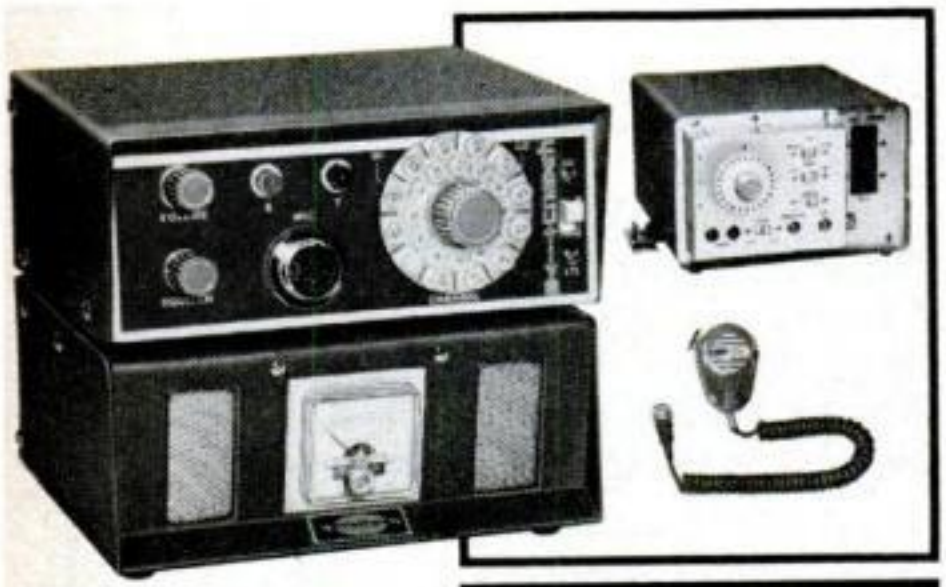

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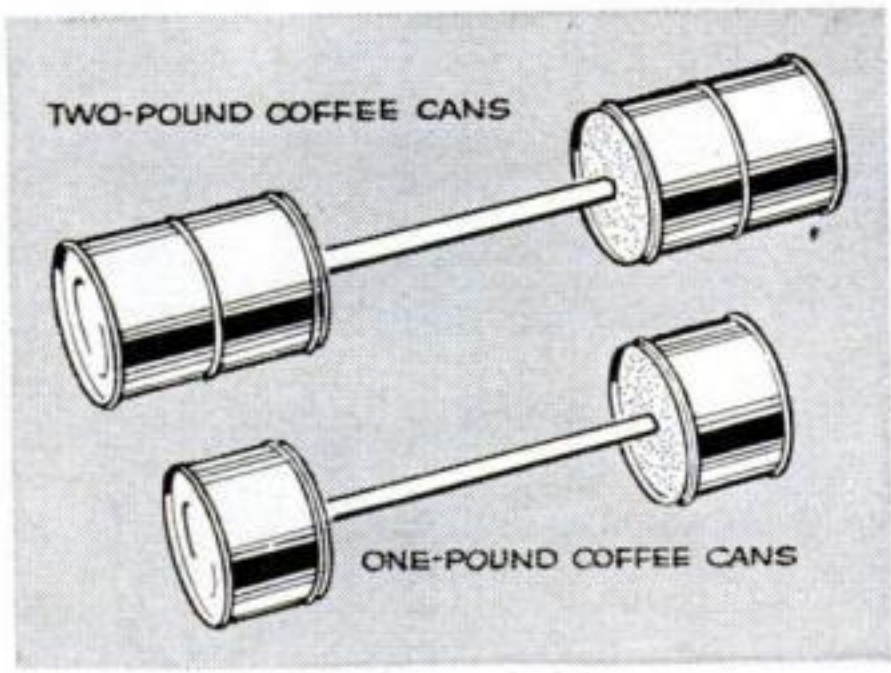

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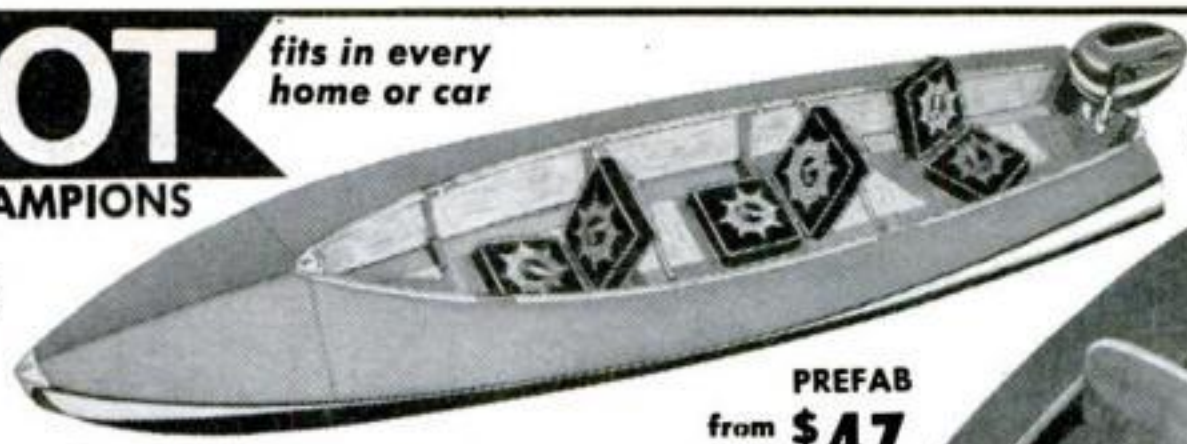

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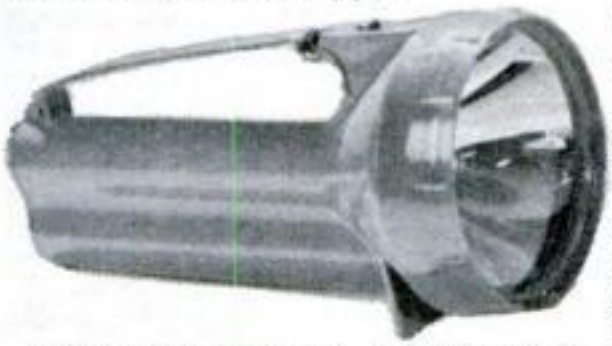

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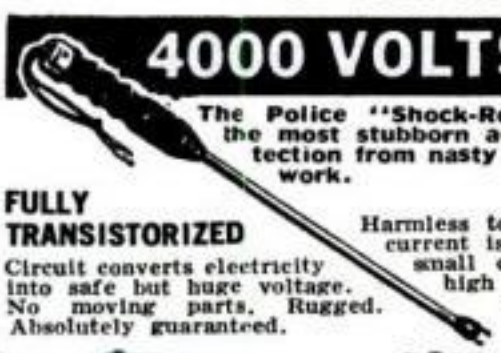

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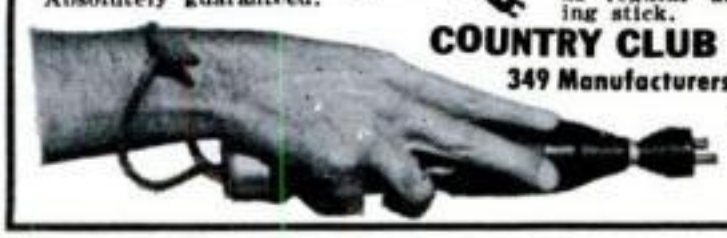

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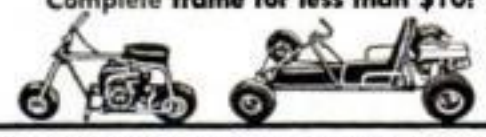

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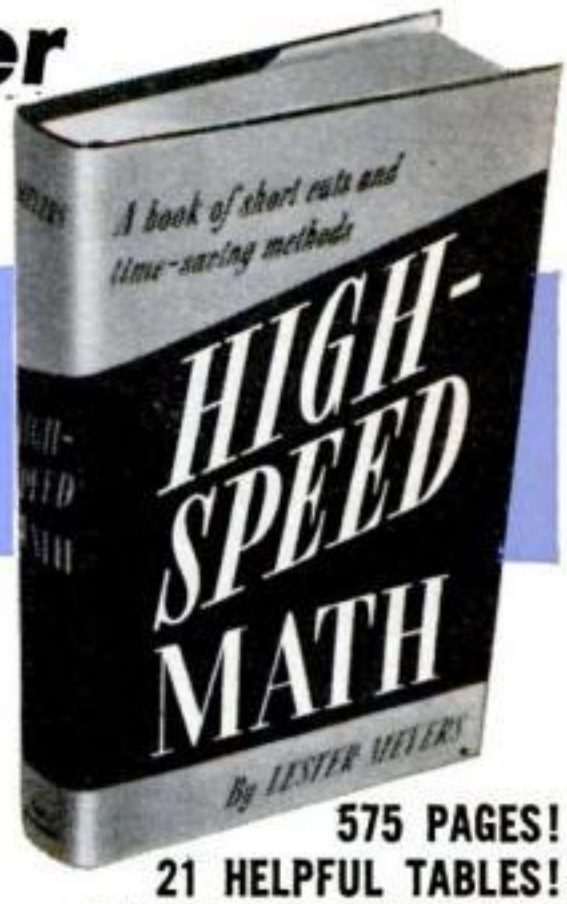

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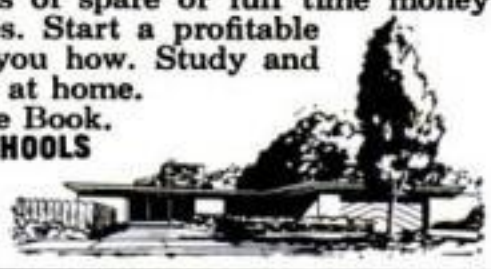

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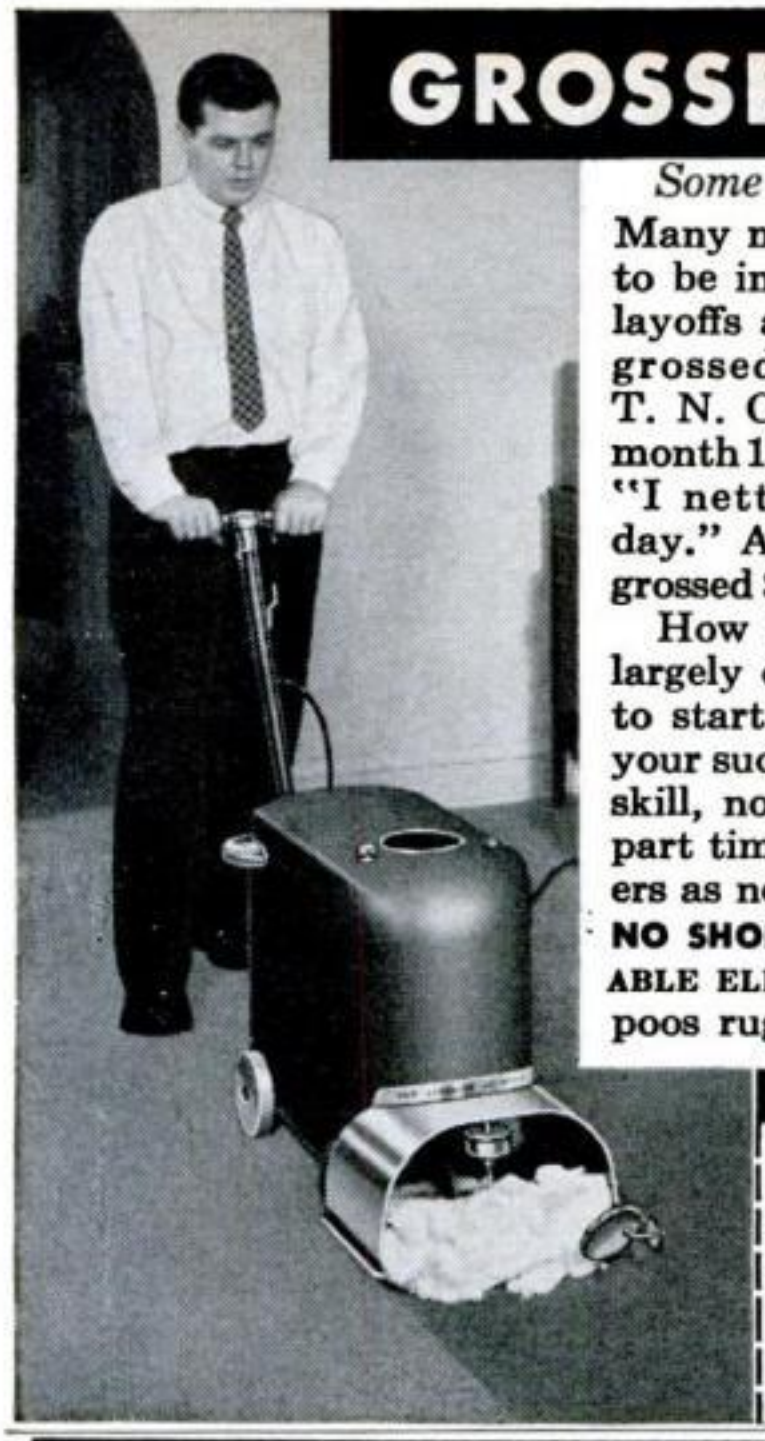

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Detroit report...

TIME IS ALMOST UP FOR CHEVROLET POWERGLIDE automatic transmission. Word is out that a three-speed-plus-torque-converter automatic will be available as an option (probably teamed with V-8s only) on big Chevrolets starting next month. This transmission is Chevy's version of the new Turbo Hydra-Matic already on other GM cars. It will cost more than Powerglide but will give better performance and more miles per gallon.

WILL A GM CAR WIN THE DAYTONA 500 ON FEB. 14? A Chevy or an Olds may well take it. Reason: Bill France, head of the National Association for Stock Car Auto Racing, has outlawed Chrysler Corp.'s hemispherical-head 426-cu.-in. engine. Thus Plymouth--last year's winner with Richard Petty driving--and Dodge aren't likely to finish in the big money. Ford must return to the engine that brought victory in the 1963 500. Petty is now without a ride in a really competitive car, as Chrysler engineers were caught flatfooted by the unexpected NASCAR ruling. However, they're working hard to up the horsepower of their stock wedge-head V-8 and may run it later in the year. Olds or Chevy is expected to win because wind-tunnel tests have shown their "flow-lined" '65 bodies are up to 10 miles an hour faster than Ford or Plymouth bodies. Also, Olds has a red-hot new 425-cube V-8, and Chevy has an equally hot lightweight 389-cube engine ready for the race.

TALK ABOUT TURBINES FROM CHRYSLER CORP. is still kept purposely vague, but the report of limited production for the 1966 model year still persists. Chrysler can be expected to build 500 to 1,000 turbine cars for a massive user-test program. Nobody yet knows whether these cars will be loaned out for free, leased, or sold. They'll be distinctively styled and compact.

A SHOT IN THE ARM FOR CHEVELLES, in the form of an optional, 389-cu.-in. V-8, is due in a few weeks. This is basically a completely new engine; it's of iron but will be considerably lighter than the current 283- and 327-cube engines. The weight saving results from use of the latest precision foundry techniques which permit thinner wall sections in cylinder block and heads. This engine is front-runner in a new line of V-8s.

A FOUR-DOOR THUNDERBIRD is in the works. Slated for 1967 introduction, it will be one of a new line, complete except for station wagons. The bigger 'Birds will undoubtedly stretch wheelbase five or six inches.

Jim Whipple

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Champions use Champions!

Jim Hall wins the U.S. Road Racing Championship in his Chevrolet-powered Chaparral – equipped with Champion spark plugs. Champions deliver maximum performance – regardless of make of engine. Why settle for less in your car?

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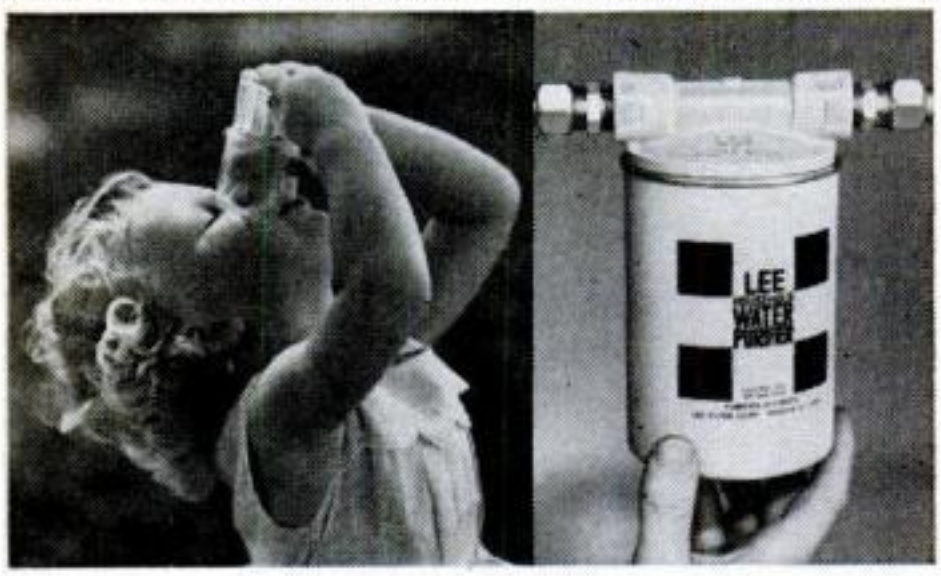

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LOCAL WATER A PROBLEM EVERYWHERE

This comment from a leading magazine is typical:

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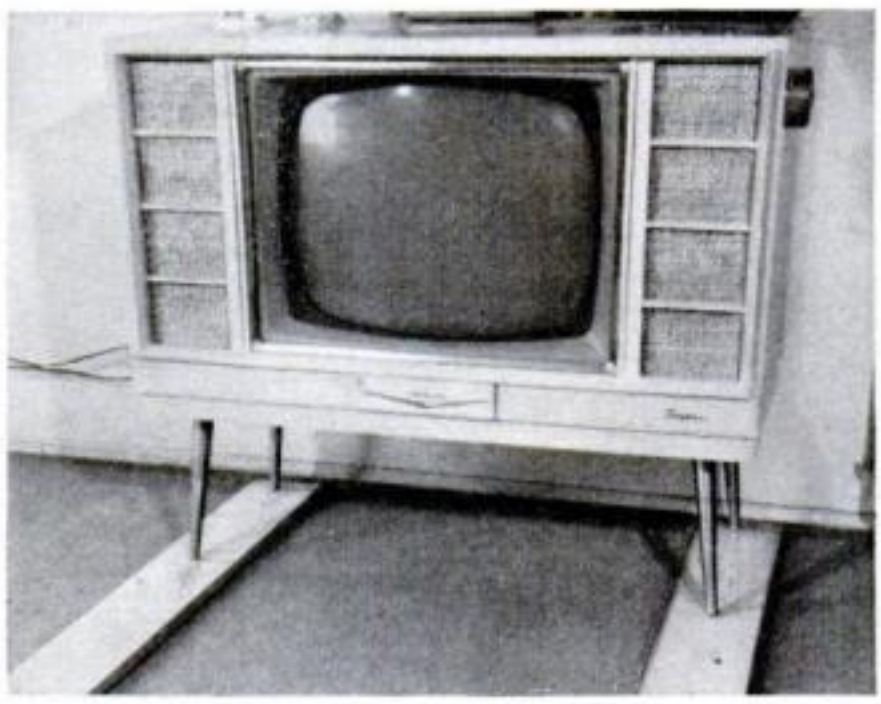
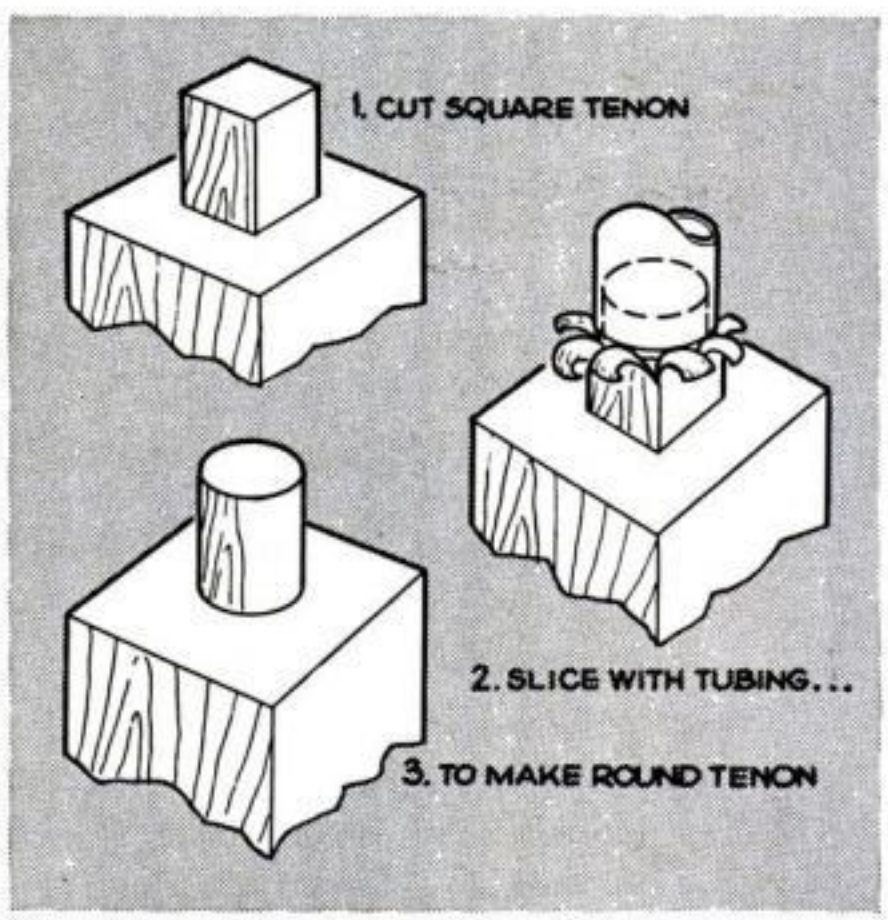
PS-2

Short Cuts and Tips FROM PS READERS



Slide—don't lift—heavy furniture

Moving heavy furniture over wall-to-wall carpeting is a one-man job with these waxed skids. Long boards, sanded smooth and coated heavily with floor wax, make shifting furniture an easy project.—*Eric E. Swanson, Whittier, Calif.*



Get a round tenon from a square cut

Here's a simple way to make tenons on small stock, such as light framing. Cut a tenon in the usual manner on a table saw—but cut square. Hammer on a piece of round tubing, sharpened at one end and of the same inside diameter as the desired tenon. The corners cut off as you go and you have a perfect dowel. Glue it into a drilled hole of the same size.—*Carl A. Roth Jr., Wyomissing, Pa.*

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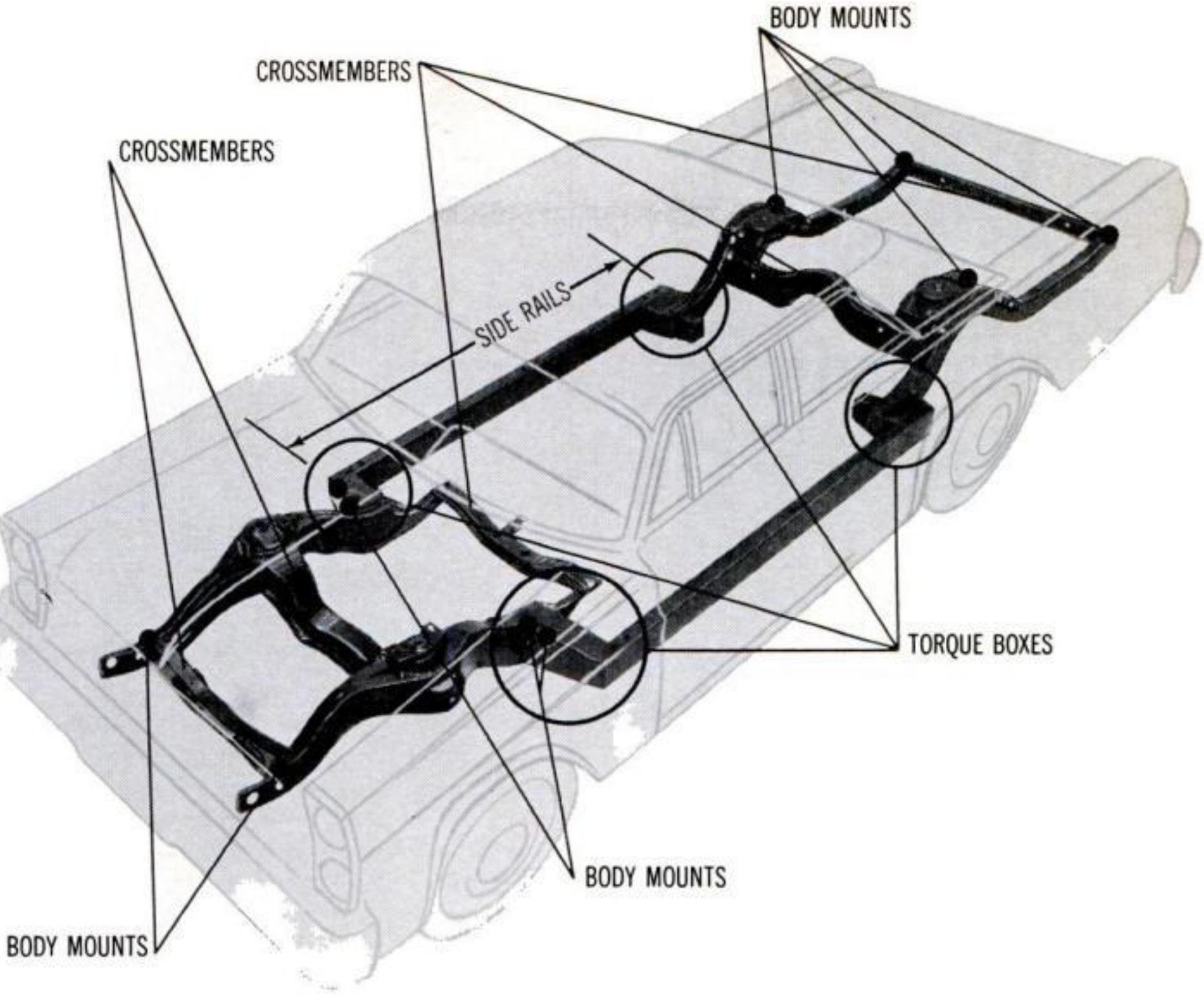

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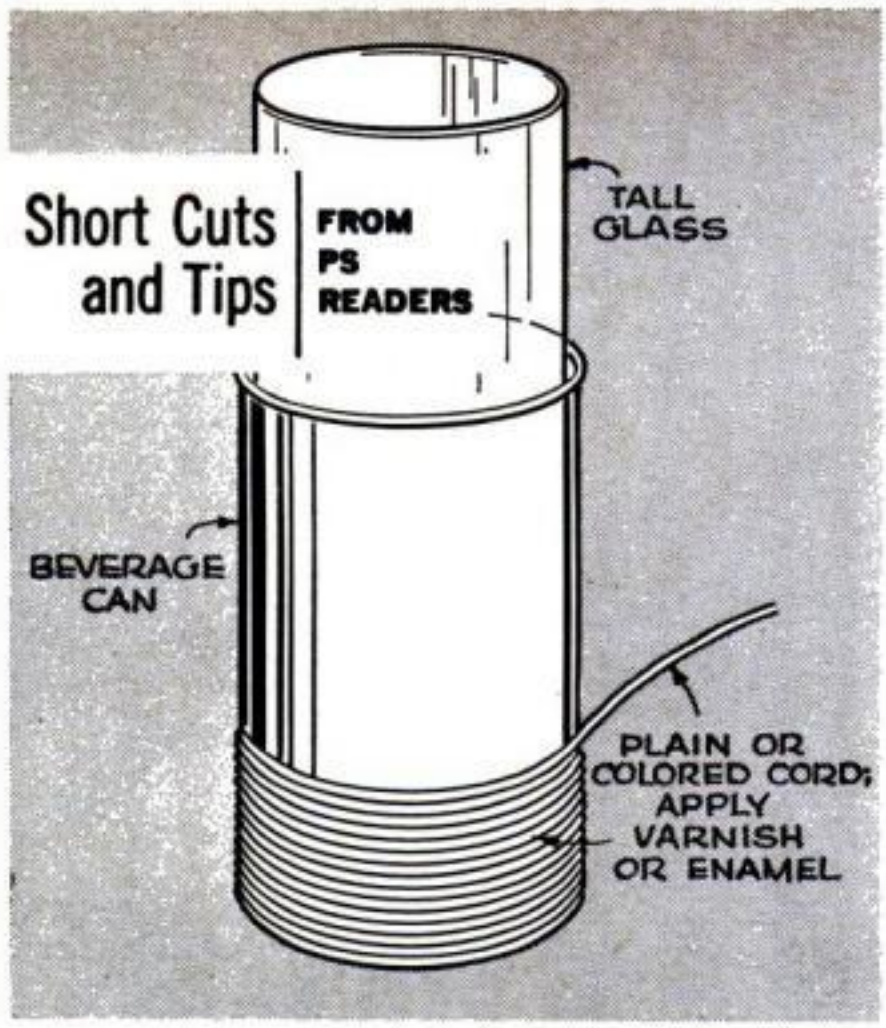
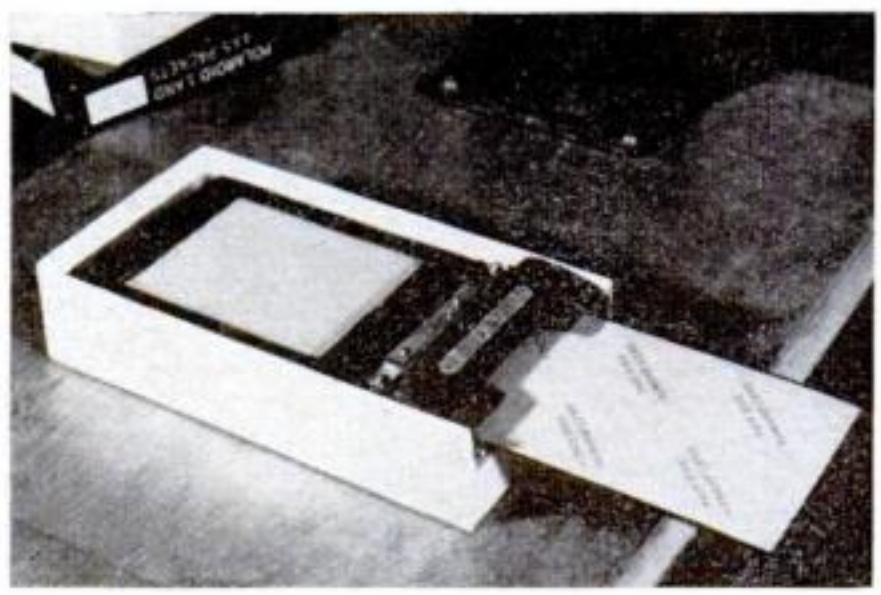


Beverage cans are attractive coasters

After removing the tops of empty cans, wrap them with close parallel windings of plain or colored cord, tucking in the ends. A coat of varnish or enamel will give the coasters an attractive and lasting protective finish.—*Ken Murray, Colon, Mich.*

►►► Try using evaporated milk instead of water in ordinary plaster of paris and you have a slow-drying (20-minute) patching plaster. Casein in the milk makes it stickier, too.—*Roger McGunnigle, NYC.*



Quick enlargements with Polaroid

Here's a quick no-trays, no-mess way to make enlargements: Instead of an easel with paper in your enlarger, use a Polaroid 4-by-5 holder or roll-film back. Project the image directly onto the film. To get black-and-white transparencies, use 55 P/N film; for color, use a 212 or 302 bulb and Polacolor.—*T. Isbill, Oklahoma City, Okla.*

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Chances are, your GM car will never need another front internal gear for its transmission. But if it does, better take it where you know they use genuine General Motors replacement parts.

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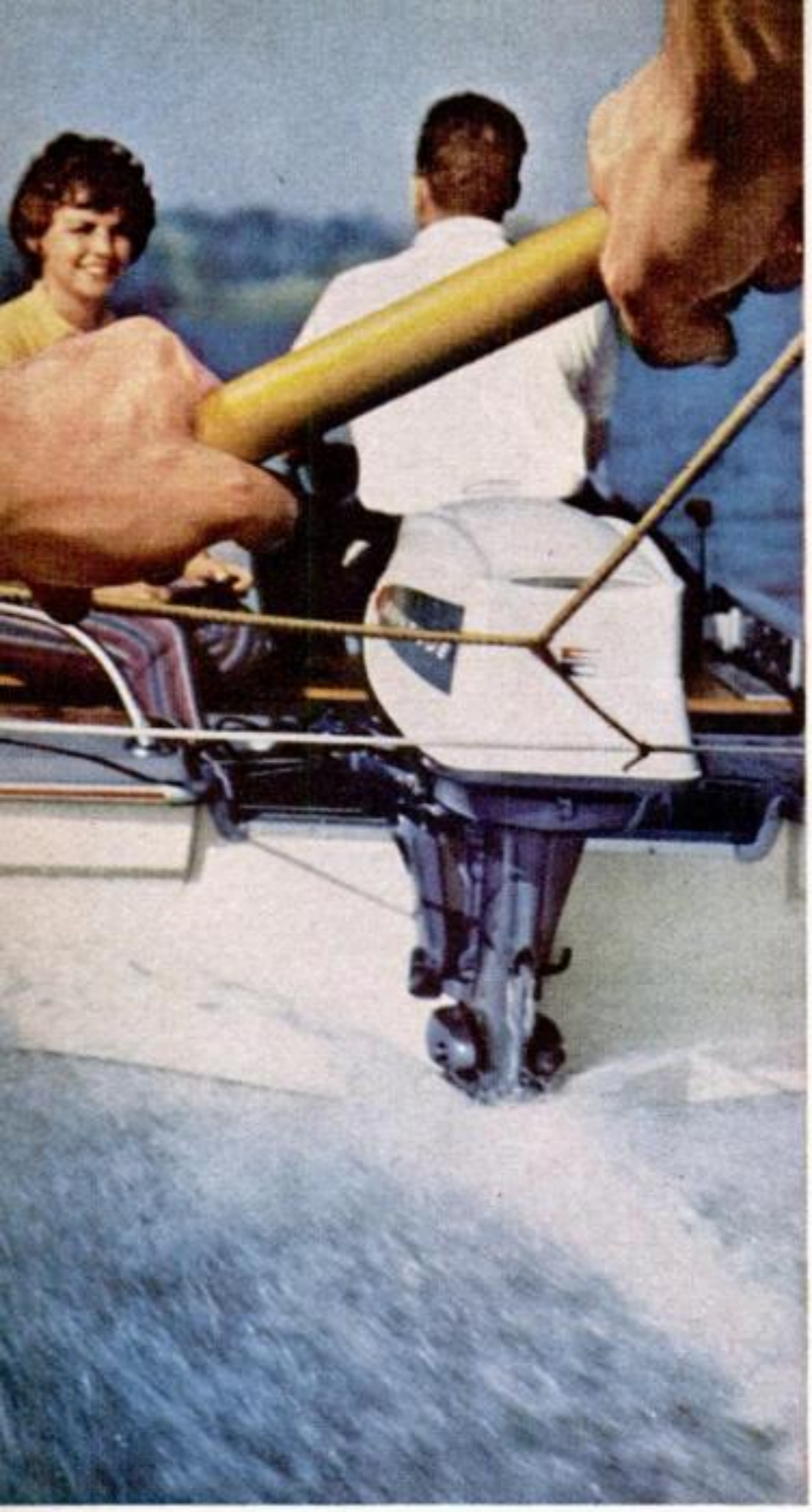

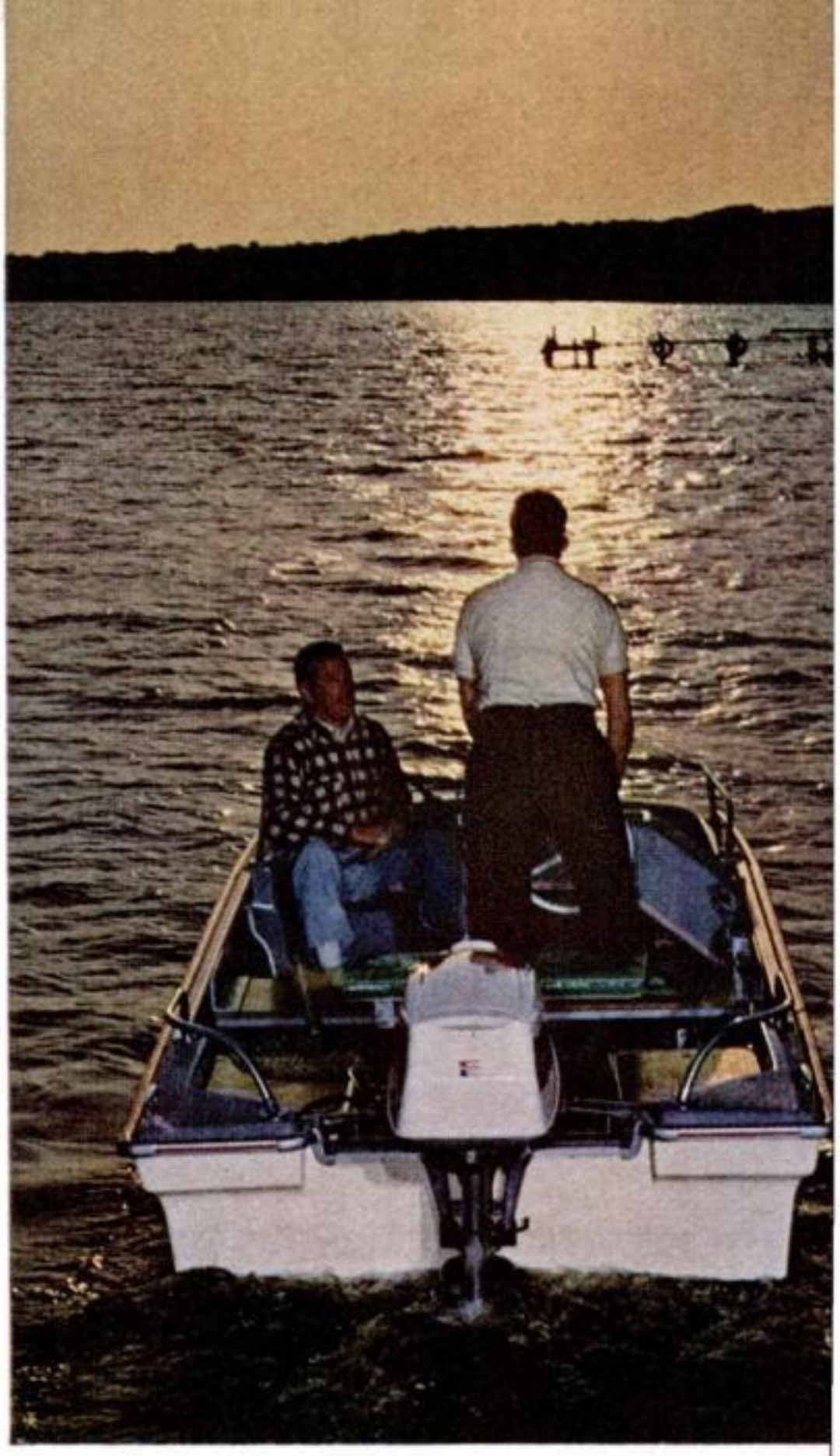

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We named this new 33 hp model the "SKI-TWIN." Its high-torque power and fuel economy make it ideal for water skiing. Its low cost puts it within reach of modest recreational budgets.

The electric starting model gives you up-front control. The powerhead is sound-sealed and rubber-cushioned. Quiet is built in. You get a choice of four props to fit your boat and load requirements. No extra cost.

At night, it sneaks out quietly to go fishing

All of which makes it a wonderfully versatile motor. Skiers soon realize this and take it fishing. It trims the time to the fishing grounds, then throttles down to a smooth, steady troll.

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Popular Science
REG U S PAT. OFF. Monthly

Are you in more danger in a SMALL CAR?

Heaping hot coals on the already heated controversy about the safety of small cars, a just-released two-year study says the injury risk in small cars is measurably greater. Small-car manufacturers and many owners hotly challenge the reliability of the data and the conclusions drawn from it. POPULAR SCIENCE assigned two top reporters to present the opposing views on the following pages. ▶▶▶

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Are you in more danger in a SMALL CAR?

YES

By Martin Mann

NOW, more than a decade after the bugs began teeming down the highways, the evidence on their safety is in. Small cars (under 2,000 pounds) are more dangerous than big cars in some important ways.

Six states have completed individual studies. The clincher is the just-released report of Cornell Lab's (Cornell Univ.) prestigious Automotive Crash Injury Research. Their findings show:

- If you are in a crash, you are more likely to get hurt in a small car, everything else being equal.
- You're more likely to get hurt bad.
- The chance of being killed goes up by 50 percent.
- You are more than twice as likely to roll a small car.
- Yet small cars get into fewer severe accidents.
- And compacts have all the same problems—just less so.

But you should also keep very much in mind what the reports do not say. They do *not* claim that small cars get into more accidents, or that they are dangerous just because they are small.

Right off the boat.

Fears about small cars came with the first shipments. Back in 1958 POPULAR SCIENCE induced Cornell's ACIR to run a special comparison of small-car accidents. Their results [PS, July '58] were not conclusive because there were then very few of the little ones on the road. Yet they were uncannily prophetic: "Small cars tend . . . to roll over . . . Injuries averaged slightly higher in light cars than in heavy cars," wrote PS seven years ago.

ACIR, collecting reports on injury-causing accidents from a dozen states, has the resources and machinery for a complete, conclusive analysis. It is objective and—despite some reliance on the Automobile Manufacturers Assn. for financial support—independent, as previous criticism of Detroit products has demonstrated.

ACIR experts re-evaluated the six state studies, and started their IBM machines digesting facts from their own files on 12,835 smashed cars.

"There are really two questions," explains ACIR's young assistant director, stocky, calm-voiced B. J. Campbell. "First, are small cars involved in accidents, or in special kinds of accidents, more often than large cars? Second, in accidents, are occupants of small cars exposed to a greater risk of injury?"

Are they accident-prone?

The answer to this question comes from the state studies, since ACIR's own data show only how many cars were in accidents, not how many *might* have been in accidents.

A 1958 U. S. Bureau of Public Roads study, comparing accident rates in four size classes, found no significant differences. New York found 10 percent of cars in accidents were small or compact, against 11 percent of registrations. These figures, the statisticians agree, show no advantage to either class of car, but lumping small with compact cars could blur a real difference.

Against these dead heats must also be balanced ACIR's discovery that small cars are more often driven by young people, who are notoriously accident-prone. Sixty percent of the drivers in small-car accidents were under 30; only 41 percent of the drivers in standard-car accidents were that young. So it may yet turn out that, other things being equal, small cars do escape accidents easily. The best that can be said now is that the question is unsettled: There is no clear evidence that small cars are more likely or less likely to get into accidents.

The kind of accident is something else

[*Continued on page 228*]

Are you in more danger in a SMALL CAR?

NO

By Devon Francis

MY ROLE seems to be devil's advocate in the case of the Cornell auto-accident report, and I am just the man for it. I own one of these infernal "small" cars—a compact—and I love it. My son owns a car in the Renault-Volkswagen class. Together, we're ready to clobber Cornell.

To begin with, I distrust statistics, especially when they are manipulated (or "adjusted," as the Cornell people like to say). I am reminded of the story of the one case of typhoid in a place housing 100 persons. Statistically, there are 99 persons who are 99-percent healthy and 1-percent sick, and one person who is 99-percent sick and 1-percent healthy. This, of course, is absurd.

Statistics are slippery things. Consider the tables in the appendix of the Cornell study. There are 14 of these things containing more than 2,000 statistical entries. Excluding persons injured by being thrown out of a car (on the reasonable premise that your hurts are equal whether you are pitched from a Cadillac or a Volkswagen)—and on the basis of crude, or "unadjusted," figures—I added up how many times the different cars came out worst, middling, or best on safety. In my simple arithmetic, here's how they shaped up:

	Worst	Median	Best
Small Cars	5 tables	4 tables	5 tables
Compacts	4	5	5
Standards	5	5	4

But on "adjusted" data, it's this way:

Small	7 tables	3 tables	4 tables
Compacts	7	4	3
Standards	0	7	7

The statistics don't get any less slippery when the Cornell people explain their "adjustments" this way:

". . . crude. . . injury rates may possibly give an erroneous indication of the relations among the three car-weight groups simply because the groups are different in accident type and severity.

"This difficulty is countered by adjusting the rates. . . [This] means calculation of average rates in such a manner as if the accident-type and severity distributions were identical for the three car-weight groups."

Then, the report adds: ". . . adjusted rates are no more 'correct' than crude rates, nor are crude rates more 'correct' than adjusted rates. Both serve a useful purpose, both are 'true' in one sense and 'artificial' in another."

At this point, they've lost me.

Built-in safety. My son put the finger on this point. "This thing is clear out. I don't see any reference to the fact that small cars have a safety factor in lower power. They can't go as fast."

A Volkswagen importer took the Cornell report to task like this:

"Here you have an expensive analysis covering six years and 20 states, with 53 people killed in small cars, 54 in compacts, and 692 in big cars. Suppose a freakish accident boosts that figure of 53 killed to 56? That raises the percentage of total small car deaths from 6.7 to 7. What do you think that's going to do to an 'adjusted' figure?" He went on:

"What is Cornell doing with the figures? In text Table 6 the 'ejected' car occupant in an accident comes off best—on the 'crude' figures—in a compact car. But on the 'adjustment' the big-car occupant comes off the best."

See what I mean by statistics?

Renault, Inc., blew its top.

Driver patterns. Cornell devoted one table to the age groups involved in its study—statistics which were not, however, "adjusted" into the final summary. Of this, Renault said:

[*Continued on page 230*]

LBJ's Heart:

What the medics learned about his ...and about yours

By Curtis Mitchell

Co-editor with Dr. Paul Dudley White of the book, "Fitness For The Whole Family"

TEN years ago, the man who is now the most powerful world leader lay between life and death in Washington's Naval Hospital.

On July 2, 1955, the heart of Lyndon Baines Johnson had succumbed to years of abuse and neglect. It fluttered wildly under the punishment of cardiac shock as his blood pressure plummeted to zero over 40.

Lady Bird sat at his bedside, holding his hand and thinking of his recent words: "Stay right here with me. I think we're going to get through this thing. If we don't, my will is in the safe down in Austin."

The attack had hit the 46-year-old senator en route to the Virginia home of a friend. At his destination, he asked for bicarbonate of soda. Senator Clint Anderson, another guest, saw his ashen face. "You don't have indigestion," he said. "You're having a heart attack."

Within minutes, Johnson was in an ambulance racing across 40 miles to the hospital. "I'd like a cigarette," he said. "If you do," the doctor told him, "it may be the last one you'll ever smoke."

The political course of LBJ's subsequent life is history, but the parallel account of the change in his way of living has never been told.

Within hours of his arrival at the hospital, Lady Bird had assembled the medical team that finally coached and bullied him back to health. They were: Dr. J. Willis Hurst of Atlanta; Dr. James C. Cain, an old friend from the Mayo Clinic; Dr. Howard B. Burchell, also from Mayo; Dr. J. Lawn Thompson of Washington; and Dr. George W. Calver, physician to Congress and medical advisor to LBJ.

Their job was awesome. Their patient was famous for his nonstop wheeling and dealing, his long hours, his disregard of health rules. He was a perfectionist, a driver. Lady Bird told someone: "Lyndon always acts as if there'll never be a tomorrow."

On that night in July, it seemed that he might be right. Suddenly he was a medical statistic. The daily toll of cardiac disease in America is always astonishing. On the day Johnson was struck down, 10,000 Americans died of it.

For two days the public heard rumors that the senator was dying.

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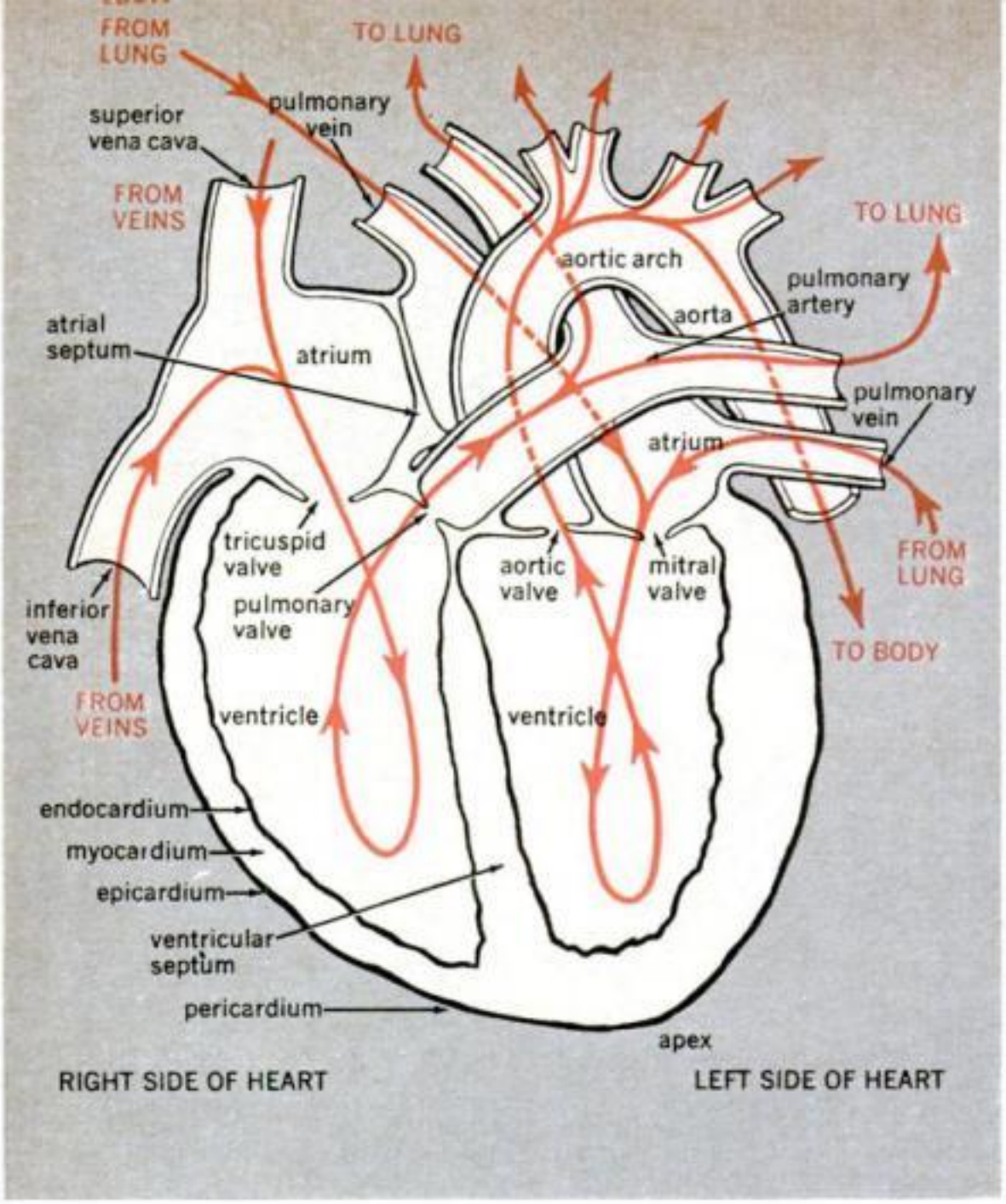


The heart is a pump

Blood is pumped through thousands of miles of arteries and veins. After circling through the body, it collects in the large veins of the trunk called the superior vena cava and the inferior vena cava, and then flows on into the heart's right atrium. This vessel contracts and squeezes it into the right ventricle, which contracts in turn and pumps it through the pulmonary artery into the lungs, where it is cleansed and oxygenated.

Returning through the pulmonary veins, from both lungs, it collects in the left atrium. This contracts and squeezes it into the left ventricle, which contracts in turn and pumps it through the aortic valve into the body's great blood vessel, the aorta (aortic arch). It is then sent on its way to distribute nourishment and oxygen throughout the entire body.

LBJ: "I wish someone had told me sooner"

Then Dr. James Cain's statement cleared the air. It called the attack moderately severe. It said he was recovering satisfactorily but "under no circumstances can he return to his duties this session. He cannot undertake any business whatever for a period of months."

Slowing down LBJ. For 35 days, the 17th floor of the hospital became the LBJ home and office. Lady Bird moved into the next room and his staff took over the remainder of the wing. President Eisenhower and a host of visitors paraded through his room. Slowing down Senator Johnson, his doctors learned, was a man-size job.

Taking his history, they learned about the man he had been. For years, he had worked seven days of every week, from 10 to 18 hours each day. Five phones stood on his office desk and he often talked into three at a time. Breakfast was black coffee and four cigarettes. Lunch was skimped. Arthur Krock, of The New York *Times*, once met him for a midday meal and reported that Johnson arrived 30 minutes late, left the table eight times for phone calls, and rushed away from his half-eaten food to meet a delegation.

At the hospital, doctors told Johnson how he would have to live in the future. To their amazement, he was surprisingly cooperative.

A week after his electrocardiogram indicated that his heart wound was healed, he and Lady Bird flew to Texas.

The new regime. Johnson had already stopped smoking, but he kept a full pack on a table to test his will. He was told to cut his calories to 1,500 a day, that his ideal weight was 185 pounds. Always a go-for-broke performer, he restricted his calories to 1,200 a day and reduced to 175 pounds. Lady Bird sent his suits out to have their 42-inch waists cut down to a slim 36.

When Ancel Keyes, the world's best-known nutritionist, told him to keep his intake of fats below 50 grams, he bought an instrument not one American in 10,000 has seen, a gram scale. Lady Bird made

Urheberrechtlich geschütztes Material

up calorie cards to which he referred religiously. *She* lost 14 pounds.

His advisors had prescribed a mile walk each morning and each evening. He measured trails in all directions. As time wore on, he lengthened his mile walk to include dove hunting. This was a new Lyndon.

"I've learned the hard way," LBJ said. "I sure wish somebody had told me sooner what I was doing to myself."

The middle-aged young. What he had done to himself was what most Americans seem to be doing: to indulge in practices that assure premature cardiovascular disease. Many authorities are saying that middle-age now begins in a man's twenties.

As evidence, they name two research studies. In Korea, the bodies of 300 young soldiers were autopsied. Practically all their arteries were filled with the fatty signs of arterial disease.

In Boston, Dr. Paul Dudley White and associates opened the arteries of scores of men who had died from all sorts of causes. They found degeneration and sludging in the arteries of all but the very young.

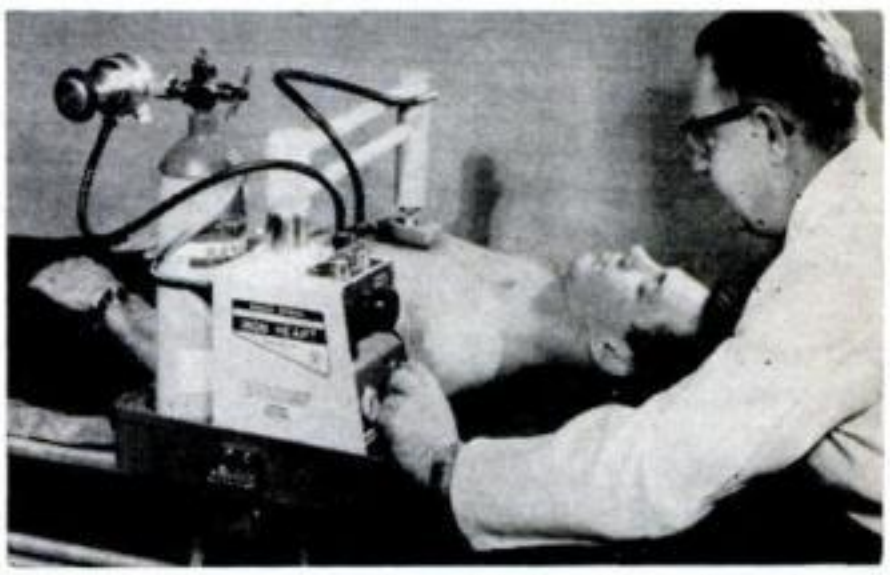
Our U. S. Public Health Service recently estimated: "Fourteen million Americans have been diagnosed as having heart disease and another 14 million are suspect." Twenty-eight million out of our 111 million adults.

What is our trouble? Physiologically, it is the premature aging of our arteries. For reasons that are still debated, the inner lining seems vulnerable to fatty plaques—abnormal deposits—and streaks that may calcify or ulcerate and form clots. Two of our most vulnerable vessels are the coronary arteries. These serve the heart itself, fitting about its top like a crown. Because the heart flexes constantly, they must flex constantly, with some wear and tear. They are the site of most cardiac distress.

If any bit of clot lodges in any part of them, or if a plaque forms that prevents blood from reaching working muscle fibers, that part of the heart muscle dies quickly and becomes useless.

Faltering hearts today are kept beating with pacemakers like this Westinghouse pace-monitor unit, which stimulates the heart with electric impulses if beat becomes irregular or stops.

Implanted pacemakers, worn by many persons, allow them to perform normal activities. External control (above) can be inductively coupled to a pacemaker to step up the heart beat.



An ambulance iron heart helps keep heart victims alive by rhythmically pressing down on chest to maintain beating. This Westinghouse unit is driven by a tank of compressed gas.

Meanwhile, back at the ranch, LBJ was giving his rehabilitation program a real go. The advice of Ancel Keyes was being followed with a fervor close to religion: Cut back your fat intake until it is less than one-third of your total diet. Use mostly vegetable fats.

Does cholesterol, a product of animal

[*Continued on page 220*]

Urheberrechtlich geschütztes Material

I Flew in the AIRLINER That LANDS ITSELF!

The day isn't far off when transports will deliver you to your airport in weather when even the birds are walking

This 50-ton monster is about to touch down on an airport runway without a hand on controls.

By Devon Francis

ONE day last December an intercontinental jet airliner took off from Paris headed for New York. It never got there. It flew first to Montreal, then Detroit, finally to Boston. Passengers straggled into New York hours later by bus and train.

The reason, aggravating to passengers, crew, and airline alike, was fog. Airplanes today can't land in fog or blinding snow—on scheduled flights.

Tomorrow they will. Airliners will land themselves, automatically.

I know. I flew in one the other day that landed as soft as eiderdown while the pilot and copilot sat there with their hands in their laps. Now and then they punched a button or turned a knob.

I took off for this flight in a 530-m.p.h. 64-passenger United Air Lines twin-jet Caravelle. For this, a demonstration, two big closed-circuit TV screens mirrored the plane's instrument panel, throttle pedestal, and captain's control wheel. The cabin-window curtains were drawn to make believe the ceiling and visibility outside were zero.

"We're at 3,000 feet," said a voice from the cockpit on the speaker system. "We're on autopilot and altitude-hold, and we're cleared for approach to the ILS [Instrument Landing System] runway."

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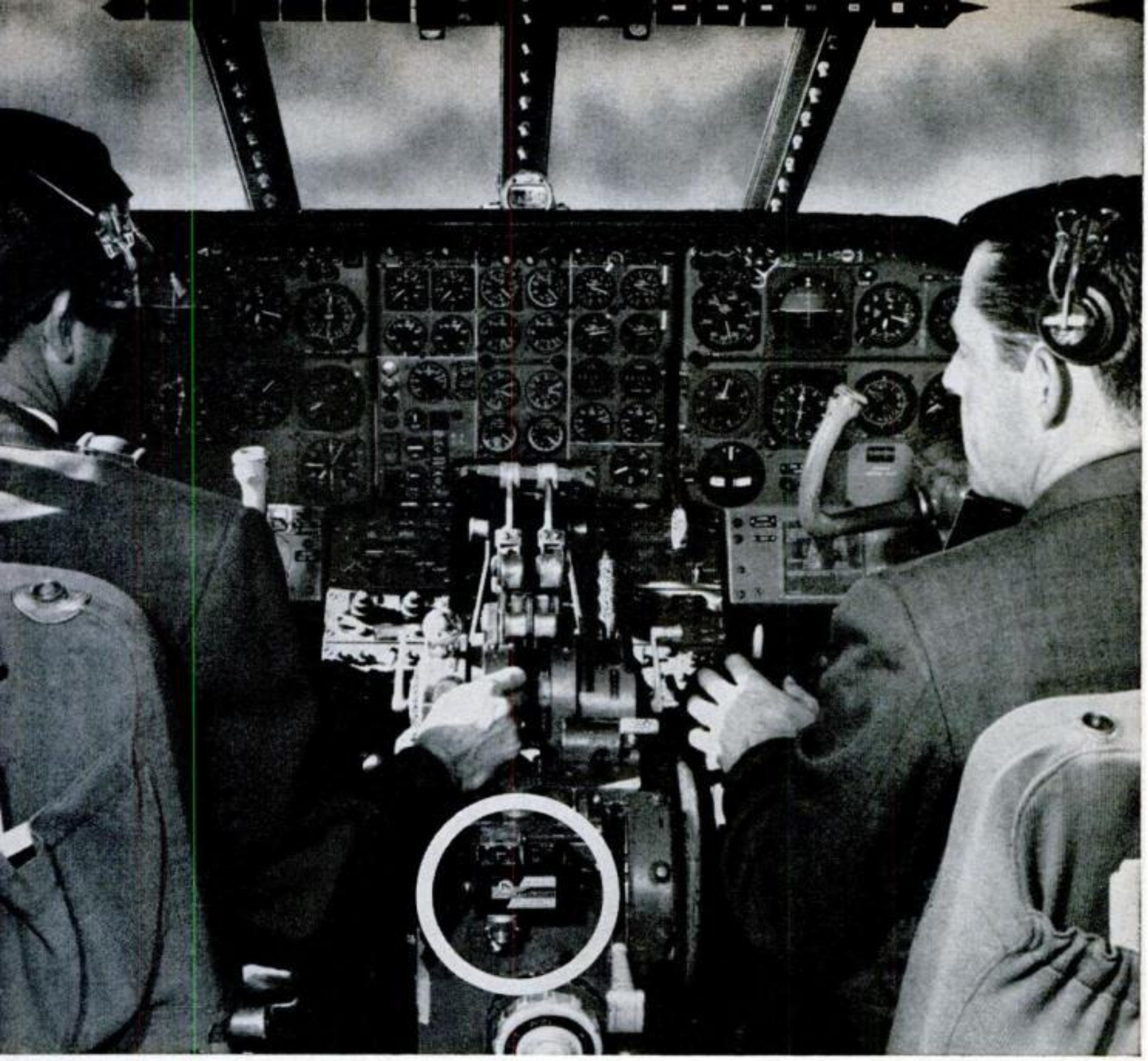

Small instrument on throttle pedestal (circled) turns automatic landing system on and off.

On the TV screens the air-speed needle read 150 knots. The plane was in a gentle turn.

"We're cleared to the localizer intercept heading, and descending to 2,300." The compass read 235 degrees. The captain pushed a button on a small fixture at the back of the throttle pedestal—the Automatic Landing-System Selector.

"We're about nine miles from touchdown." Not quite a minute went by. "We've intercepted the ILS localizer and automatically captured it." The compass read 190 degrees. "Now we're about seven miles from touchdown. We've set the autothrottle command at 144 knots."

This, too, had been done on the ALS Selector by turning a knob until the figure "144" appeared in a tiny window.

Meantime, the copilot had clunked down the landing gear, lowered the flaps, and raised the speed brakes on the wing.

"We've captured the glide slope and set the autothrottle command at 134 knots." Without a finger on them, the throttles retarded. The air speed sank to 134.

"We've passed the outer marker at an altitude of 1,300 MSL [mean sea level]." That meant we had crossed a radio beacon 4.1 miles from the runway threshold and, allowing for airport altitude, were 987 feet above the terrain.

"We've crossed the inner marker." This was a half-mile from the threshold. "Now

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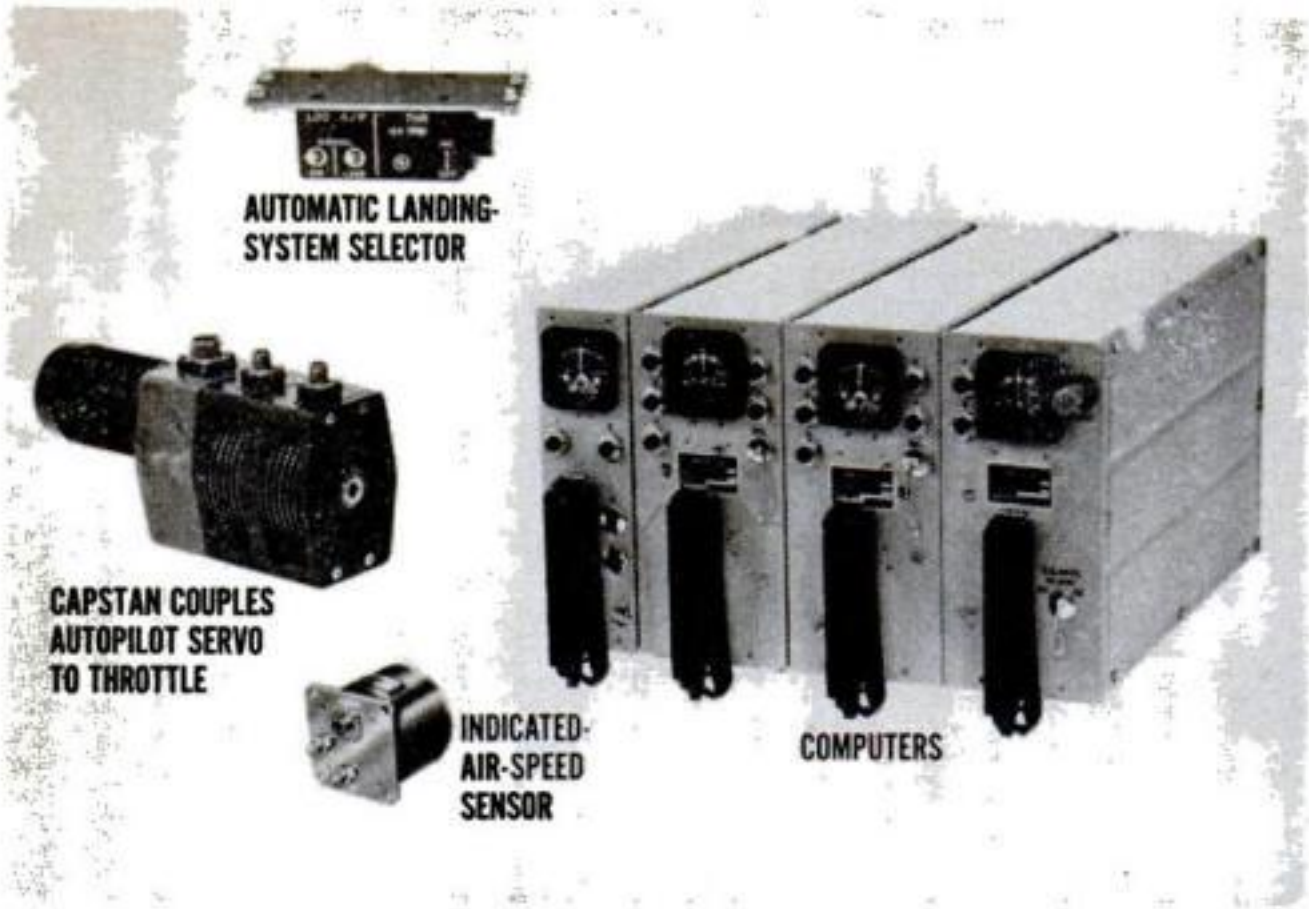

Computers make system possible

Main components of zero-zero landing system are shown here. Four computers, transmitting commands to autopilot for roll, yaw, and pitch movements, and to two capstans coupling autopilot servos to each of throttles, make system possible. Not shown is radio altimeter that triggers signal for plane to "flare" glide for landing. Altimeter is substituted for electronic glide path because latter becomes unstable at runway.

we're at 300 feet on the radio altimeter. The command speed is 124 knots."

Then: "We're over the threshold at 50 feet."

I peeked through the curtains. Yup, there was the runway. Pilot and copilot weren't moving a muscle.

"We're flaring." The plane's nose came up. The throttles retarded to 4,600 r.p.m. "We should be touching down . . ."

And at that moment we did. The air speed read 110 knots. It had been exactly four minutes, 12 seconds since the captain had pushed the ALS button.

No hands. A 50-ton plane had landed itself. Sensors had "read" its attitude (climbing, gliding, turning). Electronic equipment had locked on to a radio highway, projected from the airport.

A "localizer" beam was an invisible extension of the runway in azimuth. A "glide slope" beam offered an escalator down to the runway surface.

The attitude, speed, rate of climb or sink, and position of the plane with relation to the radio highway had been fed into four computers. These had issued orders to the autopilot and the throttles.

Nonetheless, the captain and his first officer were "in the loop," as the system's designers put it. They punched buttons and turned knobs. They lowered the landing gear and flaps and raised the speed brakes.

But most of all they watched. They monitored. They were relieved of the nerve-wracking job of manipulating elevators, ailerons, rudder, and throttles to keep the airliner lined up with the runway and on the glide slope—*and* peering through the windshield to see whether the runway would indeed materialize out of the cotton wool or snow enfolding airplane and landscape.

The system can "fail safe." Lights flash if any component flunks out, and then the captain takes over.

Other systems, too. At least three other landing systems are available to the airlines, or soon will be. The one demonstrated by United has been developed by Lear Siegler, Inc., of this country and Sud-Aviation of France. Trans World Airlines has a system it calls Auto-Scan for landing under a ceiling of 100 feet and with a quarter-mile visibility, and the British BLEU system lands airplanes when even the birds are walking.

All-weather landings will be instituted by several European airlines this year. The cautious U.S. Federal Aviation Administration is expected to approve 100 feet (altitude) and a quarter-mile (visibility) —half today's minimums—this year. All-weather operation probably won't be approved for sometime yet—until 1967 or later.

But it will be. I've seen it work.

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Today's Hero at the 500 Is Often Tomorrow's Bum

In the first of four articles on the Indiana classic, POPULAR SCIENCE'S *popular columnist ("Say, Smokey—") tells the inside story of his abortive effort to win the world's most famous auto race, the Indianapolis 500, last year, and discusses the designers of Memorial Day race cars.*

He should know about them. Smokey Yunick has entered cars for seven consecutive years at Indy, starting in 1958. In 1960 his car won.

By Smokey Yunick

MY GARAGE in Daytona Beach seems to be a sort of catchall for rumors on racing, and at this season of the year especially about the forthcoming Indianapolis 500. Thereby hangs a tale—what I'm going to do about the '65 race.

Let's go back a chapter. In 1964 I entered my "capsule cockpit" racer with Bobby Johns at the wheel. I went clear out on design. Johns hit the wall in a qualifying run, and that was it.

But for '65 the rules have changed. Nothing in a racer may extend laterally beyond a line drawn fore and aft through the inside of the front and rear tires. When I learned that my off-center capsule was illegal, I disassembled the car and started to build one to fit the rules.

Then something else happened. Rumors began percolating through my garage. I will tell you more about them next month. For the present I'm going to keep strictly to myself whether I plan to enter a newly designed car at Indy this year.

Static? Not so! A lot of race fans remember only the long years that Offenhauser engines and A. J. Watson chassis have appeared in the winner's circle. They think Indy designs are static. Nothing could be further from the truth, and let me add that today's design hero can be tomorrow's bum.

Harry Miller was fantastically successful at Indianapolis in the 1920s and '30s. But he was a visionary who wanted to improve the breed. He wanted independent suspension all around, four-wheel drive, and a rear engine with six cylinders (instead of four).

He built five cars. Not one qualified. The driver sat too far forward, and when he started to "lose it" in the corners, he couldn't sense it fast enough to recover. Miller didn't get much cooperation from the drivers. The cars were not properly tested. That was the end of Miller. But he was a superb designer, not only of chassis, but of engines. Today's Offy is only yesterday's Miller engine updated.

Then there was Lou Moore and his front-drives. Moore turned out the cars that finished one-two in both 1947 and '48, and it looked like a repeat in '49 until Mauri Rose broke a strap on his magneto in one of two Moore-designed racers. Nonetheless, Bill Holland finished first in a Moore car.

Like Moore, Frank Kurtis was a post-World War II designer. For several years he was the toast of the industry. The weight of his drive shaft and engine was offset to the left for Indy's counterclockwise track, like the driver's weight in my capsule car. Where's Kurtis today?

Fifteen years ago A. J. Watson came on the scene, and *his* cars got the publicity. But now the genius is Colin Chapman, from Great Britain.

The integral body. Chapman has come up the hard way. In designing the Lotus Fords, he must have built eight versions of closed-course racers. None could cut it. Then he adopted a design originated by John Cooper, also of England, in his Climax, and added torsional rigidity.

He accomplished that by building his chassis like a plane's. It's integral, with everything riveted and welded together. Chapman hangs Cooper's suspension on it. He may be tomorrow's Indy hero.

Next month I'll tell you what engine I think will win the '65 race.

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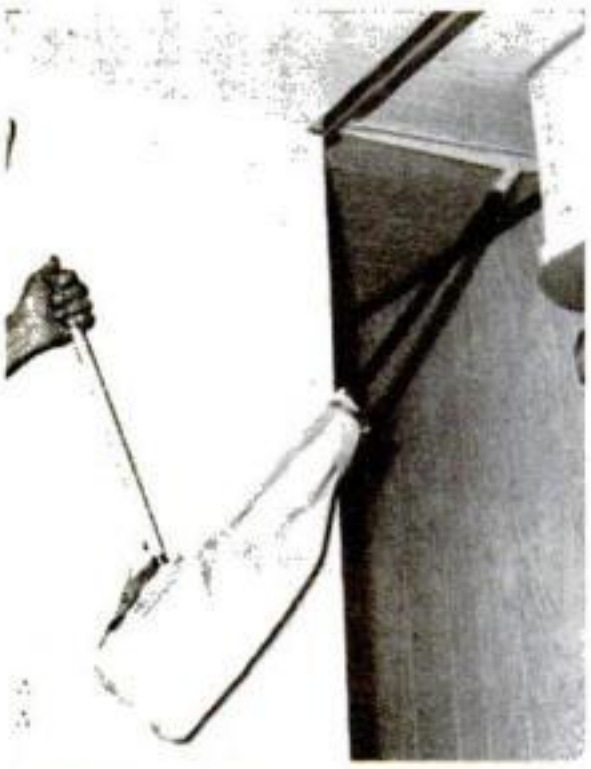
Camper fits neatly on one-ton flatbed truck with deep sides overhanging edge, windowed bed over cab.



Pumping lever up and down lifts sidewall section about a foot and pushes it out. Each side can be expanded in 45 seconds.

Expandable camper spreads its sides

Regulation eight-foot road width on the highway, this camper stretches its sidewalls at the camp site to provide 140 square feet of living space. In addition it has a generous bed off the floor over the cab.

Expanding the 12½-foot-long camper to a width of 11 feet 2½ inches is done with two hydraulic pumps and takes less than a minute for each side. First, stabilizer jacks drop to the ground; then a hinged roof section slides out and up, sidewalls move out, and the floor section comes up like the sides of a collapsible parallelogram. If you want to use the truck for other jobs, you drive its flatbed body out from under, leaving the house on its jacks.

McClure Expandable Campers, Palmdale, Calif., builds the camper for one-ton trucks, sells it for $4,000. A smaller model is made for ¾-ton trucks.

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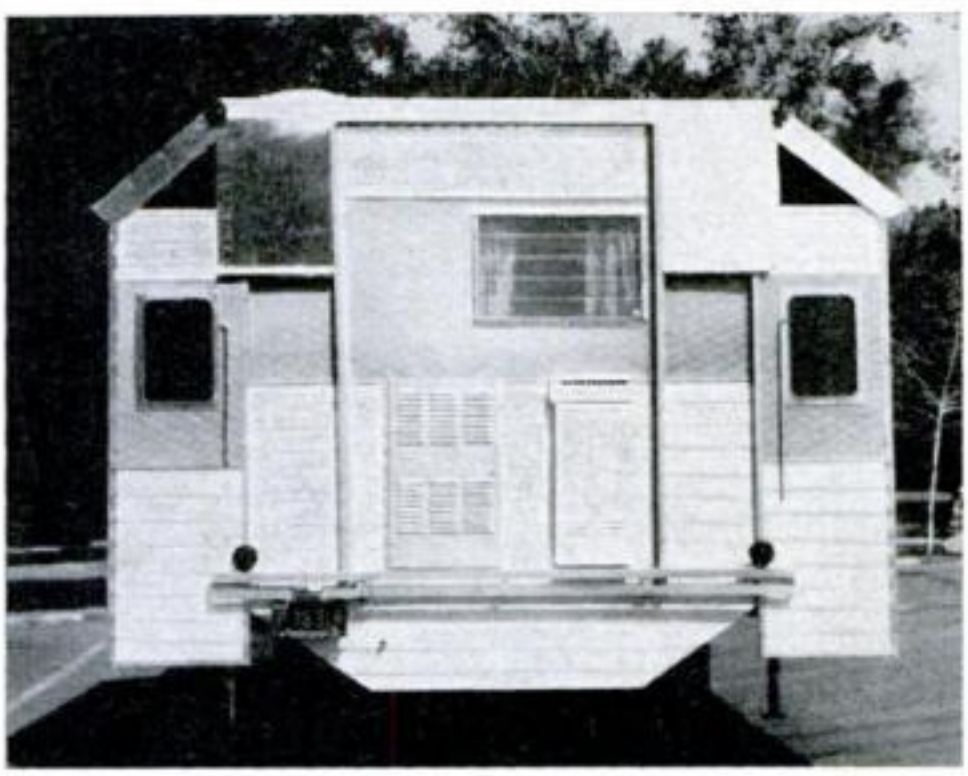
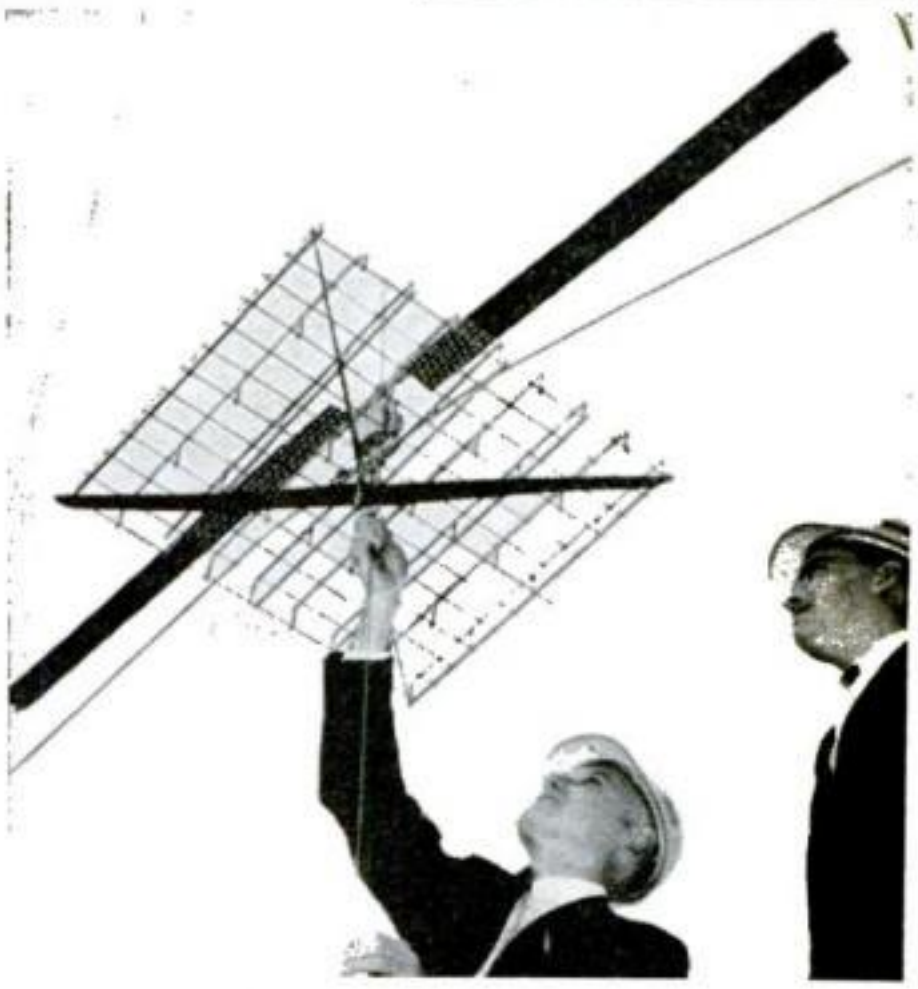
Upper panel of closed-down camper is joined to top and side by long piano-type hinges, forms part of roof when side is extended.



Sides go up and out when hydraulic pumps are operated. Stabilizing jacks drop to ground, lift camper slightly above truck bed.

Fully expanded, camper gains 40 square feet of floor space from extended sides. It can be left at camp site, truck driven off.



Microwaves power flying platform

Energy beamed from the ground spins the rotor blades to fly the helicopter shown above. A blanket of diodes resembling a bedspring acts as an antenna, collecting microwaves transmitted to it and converting them to electricity to run a motor. The model is a stage in Raytheon's development of a hovering platform for TV transmission, missile detection, aviation beacons, navigation and weather aids, and military surveillance. In tests, it rose to 50 feet.

Sightseeing boat has glass sides

Visitors to Sweden will get a protected view of its many scenic waterways from a new sightseeing boat—the Laxen. It has Plexiglas sides at eye level from seats just below the main deck. Sliding curtains provide privacy for sleepers during night cruising. The boat is 32 feet long, has a 12-foot beam, and cost about $16,000 to build.

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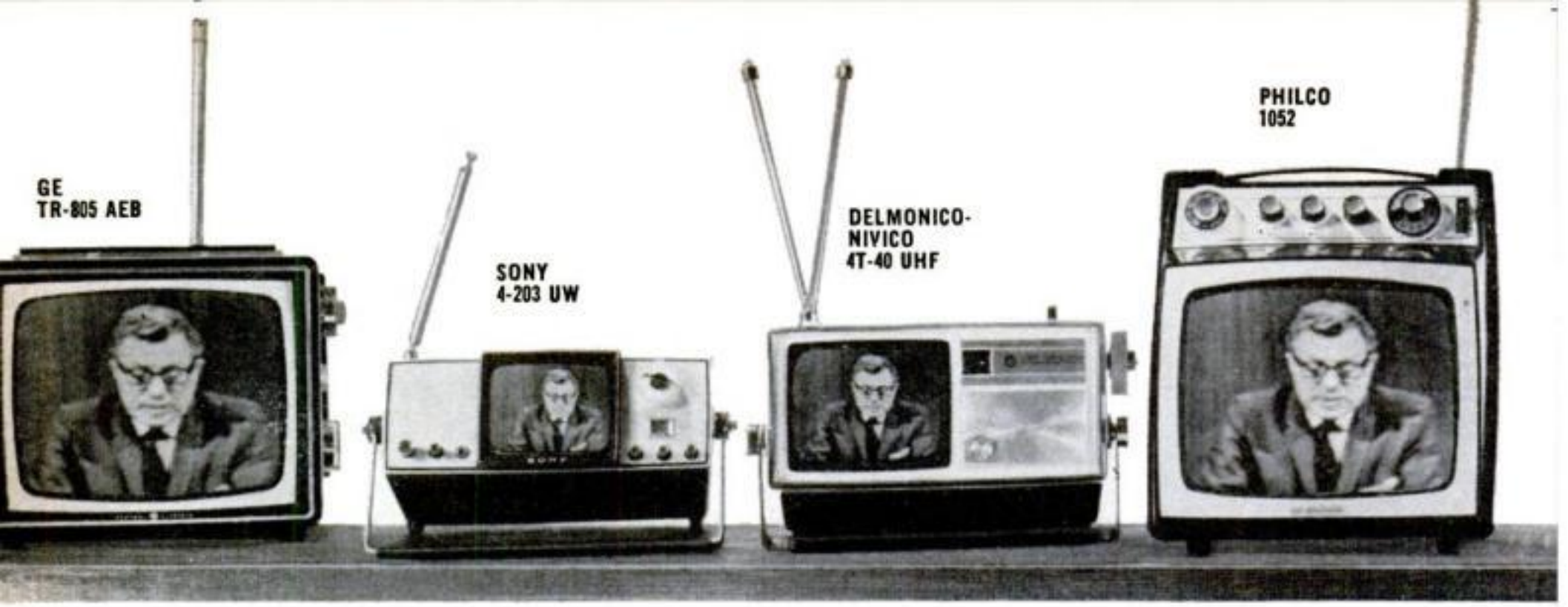

PS ELECTRONICS

Tiny TV Sets

Transistors make them totable, batteries make them portable. Here's your buyer's guide

By Ronald M. Benrey

THE first time you see one of these little TV sets, you may wonder what all the fuss is about. Didn't we get rid of those midget screens back in the early days of television? But the next time you see one—with the picture turned on—it may be a case of love at second sight.

What's happened to TV is the same thing radio went through. First we had only the bulky set in the living room. Then, with the development of transistors and the art of miniaturization, radios shrank. You could carry one anywhere, even put it in your pocket. That's what these tiny TV sets are—personal. They let you watch your favorite show—in your bedroom, car, or boat, at the beach, on a picnic.

Watch out for lampposts when you view Sony's four-inch set powered with flashlight cells. Where's the antenna? It's wired into the neck strap. The whole package weighs six pounds.

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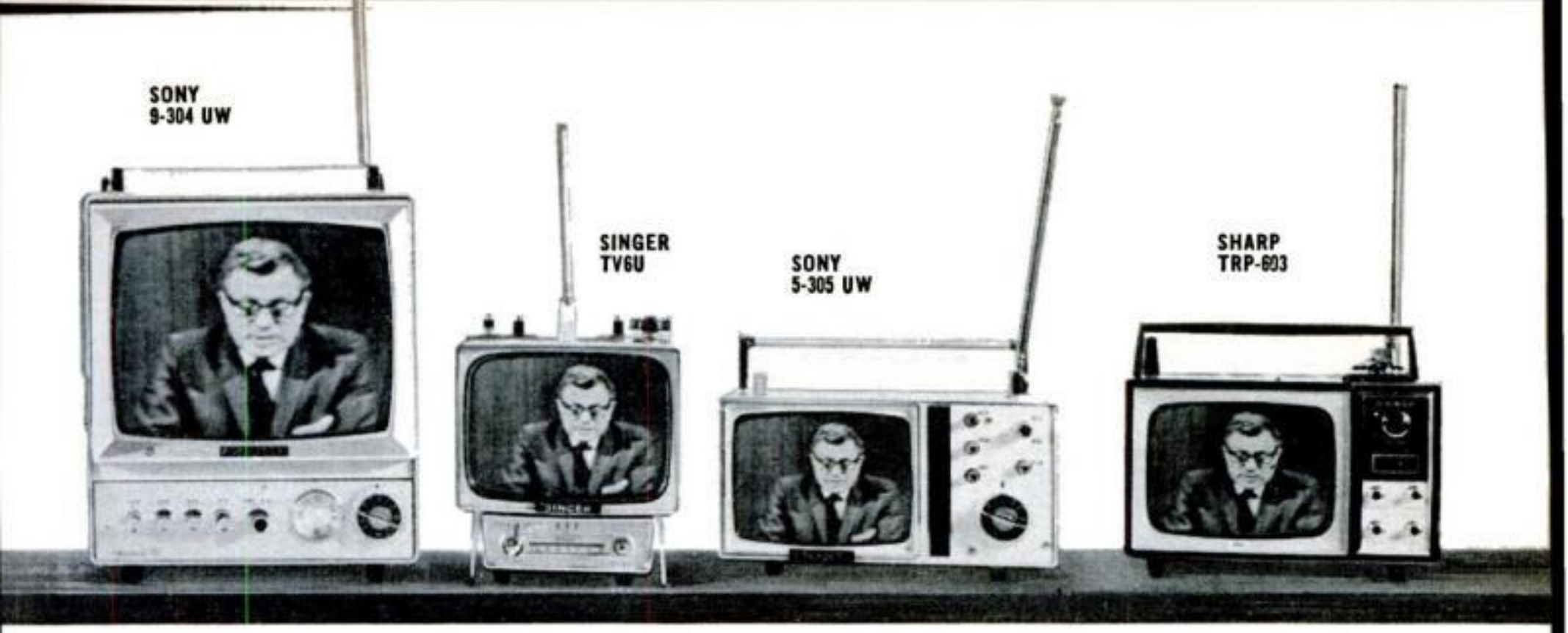

Are "In"

How much do they cost? Prices start around $150 and range up to $200—about the same as big-screen portables.

How good are they? To find out, POPULAR SCIENCE tested the eight little TVs shown above. Seven—all except the GE—are from Japan. We were surprised to learn that the Philco set is imported, since Philco manufactured, in the U.S., the world's first transistor TV back in 1959 [PS, Aug '59]. We viewed them in cities and in the suburbs; we took them to the beach and to mountain resort areas; we tried them in cars.

Our conclusions: The personal portables perform so well that they can't help but be popular. Here's why:

The miniature TVs are genuine portables. They are compact—the largest is as big as a bowling-ball bag, the smallest about the size of a desk dictionary. They are light enough to tote around—most weigh under 10 pounds, about ¼ as much as a big-screen "portable." They are full-size in performance, though, thanks to sophisticated, space-saving, transistor circuitry.

They can be powered by rechargeable battery packs as well as 117-volt AC house current, so you can view them away from the power lines. Most of the sets will run four hours on one charge;

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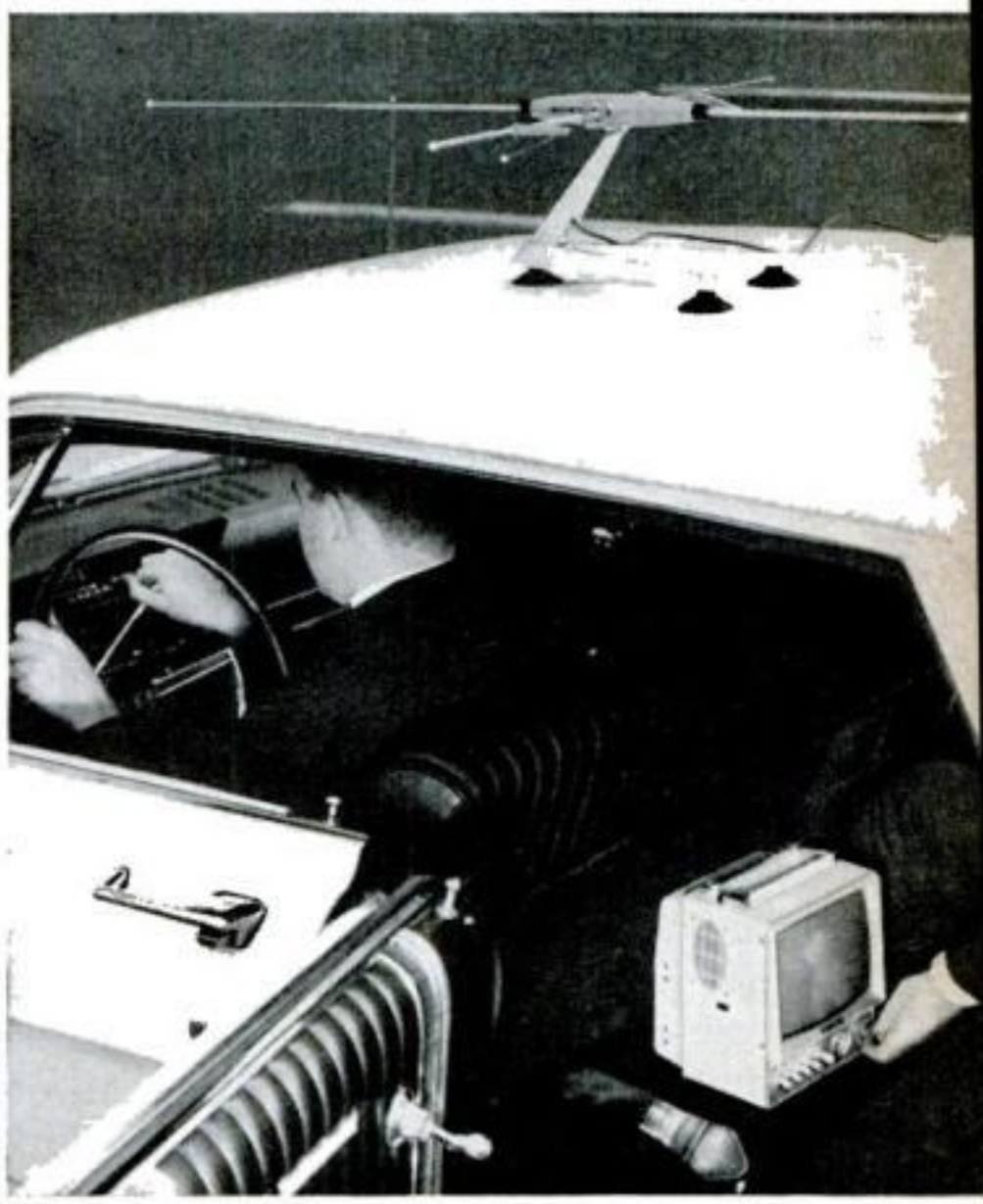
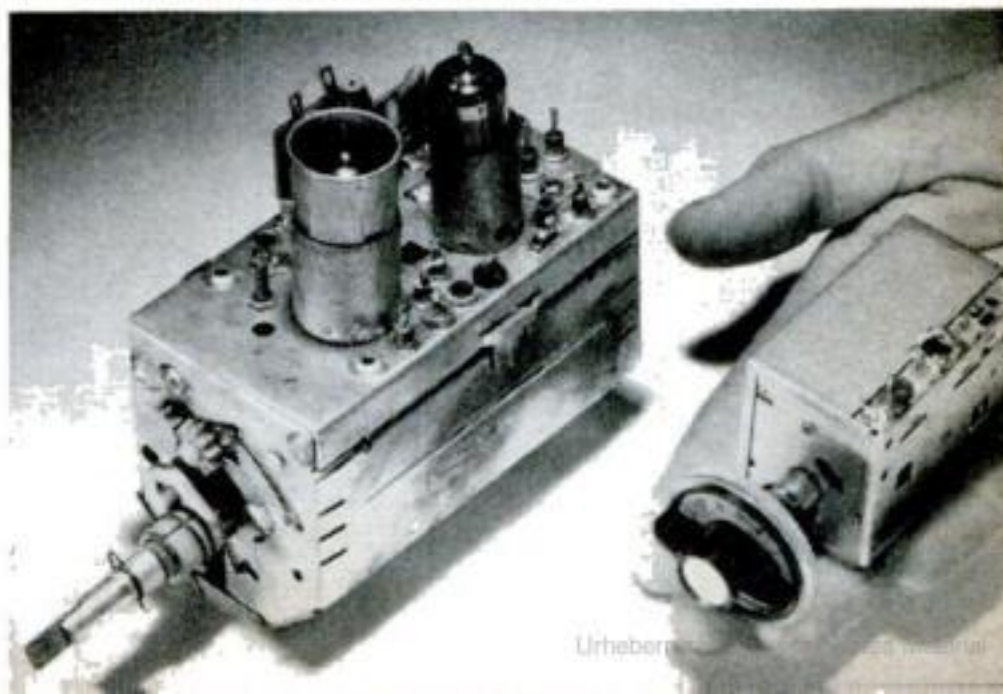


Back-seat auto TV? Sure—if local laws allow. Sony 9-304 (above) gets power from the cigarette-lighter socket. A rooftop Sony VC2A antenna sucks in the signals. Miniature parts keep the tote-alongs tiny. Shown in photo below, Philco's transistorized tuner stage alongside a conventional vacuum-tube unit.



recharging takes 10 hours. The battery can be recharged approximately 50 times before it's worn out. A battery replacement costs about $11; that works out to about six cents a viewing hour.

The Delmonico and Sony four-inch sets can also be powered by nonrechargeable flashlight cells; cost per viewing hour is much higher—about 40 cents.

Special interference-killing circuitry and a wide array of accessory mounting brackets and connecting cords let you watch them in moving cars (from the back seat, of course) and boats.

Their small screens—ranging from a snapshot-tiny four inches to a magazine-size nine inches—are perfect for close-range personal viewing.

You'll be surprised how quickly you get used to a small screen. One reason is that you can't see the scanning lines that make up the picture, as you do on a big-screen set.

Don't plan to scrap your big-screen set, though. The personal portables aren't meant for family viewing. More than two viewers in front of a tiny TV—especially the four- and five-inch-screen models—makes a crowd.

They're ruggedly built. The flyweights will ignore jouncing and rough treatment that would send a conventional TV to the repair shop. And they're equipped to travel: A carrying case or snap-on protective front lid comes with (or is an optional accessory for) every set. All of the small TVs performed flawlessly during the PS tests, although we didn't test them long enough to judge their lifetime durability. But a transistorized TV should be more trouble-free than a tube set, since the two major causes of TV-set breakdown—burned-out tubes and circuit components overheated by glowing tubes—have been eliminated.

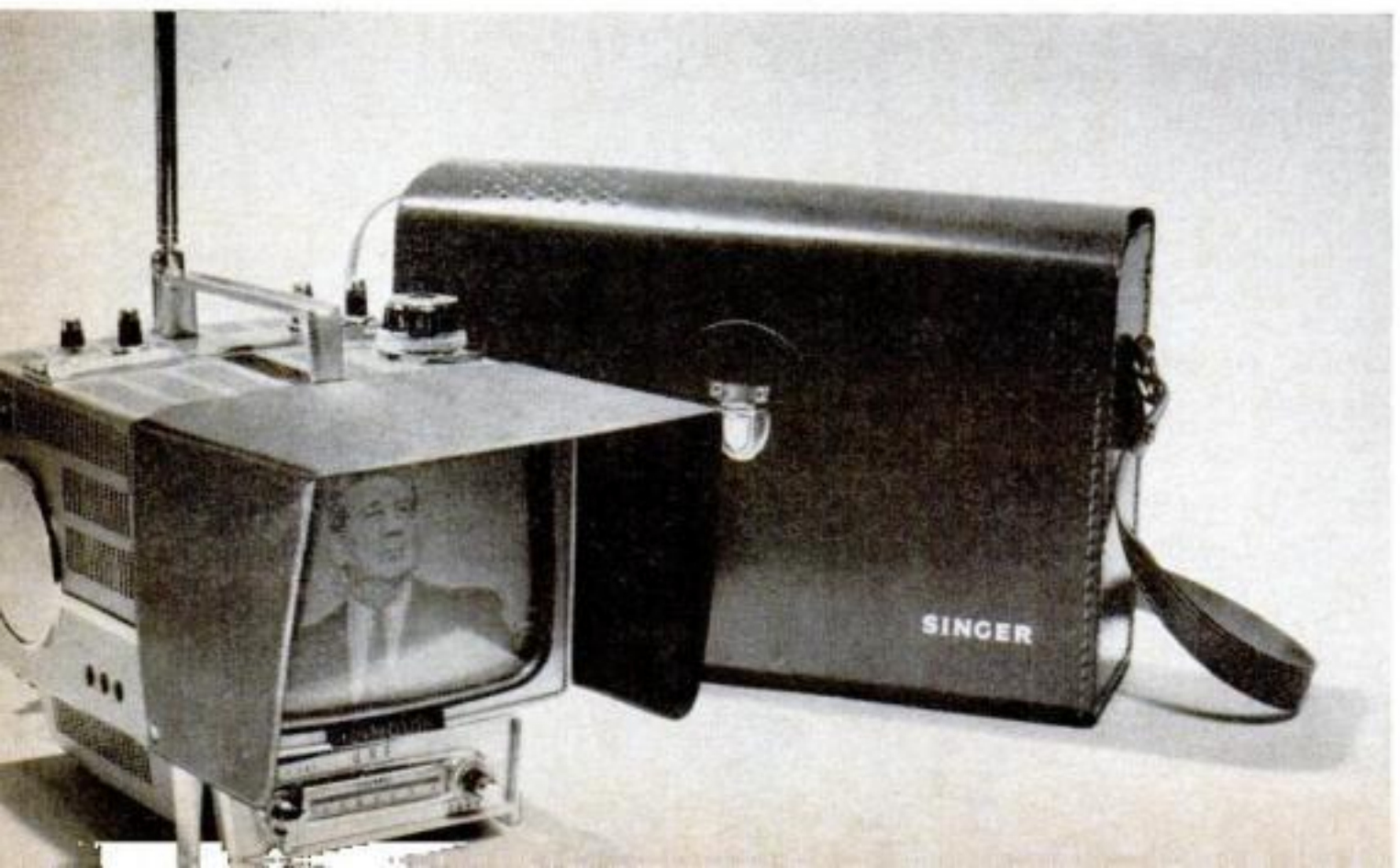
Servicing is no problem. The baby TVs use computer-type plug-in printed circuit boards that most servicemen can fix. For major repairs, the set makers maintain service depots in large cities. The sets are light enough to mail for servicing.

Their performance is amazing—picture quality and sensitivity are excellent. In a side-by-side test in the suburbs the little TVs pulled in 50-mile-plus stations with their built-in monopole telescope antennas alone; a more expensive big-screen set needed a rooftop antenna.

In keeping with the recent federal law, the sets have all-channel tuners, which means they can receive the 70 ultra-high-frequency channels (14-83) as well as the 12 very-high-frequency channels (2-13).

All the little-TV pictures are bright enough for daytime outdoor viewing. At the beach, and on very sunny days, you'll need a sunshade to cut glare on the screen.

How do they sound? Like good-quality transistor radios. To keep power drain low—so they can be battery-powered—these TV sets use relatively low-power



Accessories you'll need to watch the little TVs are shown at left: a sunshade to cut down glare for outdoor viewing, a battery pack to free you from the power lines. Singer's rechargeable battery pack will power its TV about four hours before it needs recharging. Price: $24.95.

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Buyer's Guide to Transistorized TV Sets

MAKE & MODEL	SCREEN SIZE	PRICE	SIZE Width x Height x Depth	WEIGHT	ANTENNAS	POWER SOURCES	NUMBER OF SEMICONDUCTORS	STANDARD EQUIPMENT	OPTIONAL EQUIPMENT
DELMONICO-NIVICO 4T-40UHF	4"	$179.95	8¼" x 4⅞" x 7½"	8½ lb. with batteries	telescoping dipole plus UHF loop	flashlight cells, rechargeable cells, 117-volt AC	30 transistors, 33 diodes	rechargeable batteries, earphone, carry case	auto-battery adapter cord
G.E. TR-805AEB	9"	$159.95	10½" x 9¼" x 9¾"	13 lb.	telescoping monopole plus UHF loop	external battery pack, 117-volt AC	24 transistors, 17 diodes	earphone, auto-battery adapter cord	rechargeable battery pack, carry case, auto-mounting bracket, sunshade, car antenna
PHILCO 1052	9"	$149.95	9" x 10" x 9"	10½ lb.	telescoping monopole plus UHF loop	external battery pack, 117-volt AC	27 transistors, 15 diodes	earphone	rechargeable battery pack
SHARP TRP603	6"	$149.95	8¼" x 5⅛" x 7 3/16"	10 lb.	telescoping monopole plus UHF loop	external battery pack, 117-volt AC	24 transistors, 17 diodes	earphone	rechargeable battery pack, carry kit, auto-battery adapter cord
SINGER TV6U	6"	$175	5⅞" x 7¾" x 8¼"	9½ lb. with AC power supply	telescoping monopole plus UHF yagi	external battery pack, 117-volt AC	27 transistors, 21 diodes	earphone, carry case, sunshade	rechargeable battery pack with recharger, auto-battery adapter cord
SONY 4-203UW	4"	$199.95	8½" x 3⅛" x 6½"	6 lb. with batteries	telescoping monopole	external battery pack, alkaline flash-light cells, 117-volt AC	32 transistors, 18 diodes	earphone, sunshade, protective cover	rechargeable battery pack, auto-adapter cord, auto antenna
SONY 5-305UW	5"	$159.95	8⅜" x 4¼" x 6⅝"	8¼ lb.	telescoping monopole	external battery pack, 117-volt AC	28 transistors, 16 diodes	earphone	rechargeable battery pack, carry case, auto-battery adapter cord, sunshade, auto antenna
SONY 9-304UW	9"	$189.95	8⅝" x 9⅝" x 7⅜"	12 lb.	telescoping monopole	external battery pack, 117-volt AC	29 transistors, 16 diodes	earphone, protective cover	rechargeable battery pack, auto antenna, car-mounting brackets

audio circuits: Most have a sound power output of about ⅓ of a watt—enough to produce normal volume levels indoors. Outdoors, or in very noisy indoor locations, you can use an earphone.

Choosing a tiny TV. It's harder than you think. To our surprise, all eight sets perform about the same: very well indeed. We'd be nitpicking if we singled out petty differences in picture and sound. But there are other things you should look for. Each of the sets has a slightly different personality—you should find the one that matches yours.

- The four-inch sets are strictly one-viewers—unless two people are very good friends.
- The five- and six-inch sets make ideal table-top TVs, are excellent for carrying from room to room: from kitchen table, for breakfast and the morning news, to night table for a late movie.
- The nine-inch sets make ideal second TVs. They combine the best of two worlds: Optional battery packs and a raft of accessories adapt them for use anywhere. Yet the picture is large enough for a small group to watch. ■ ■

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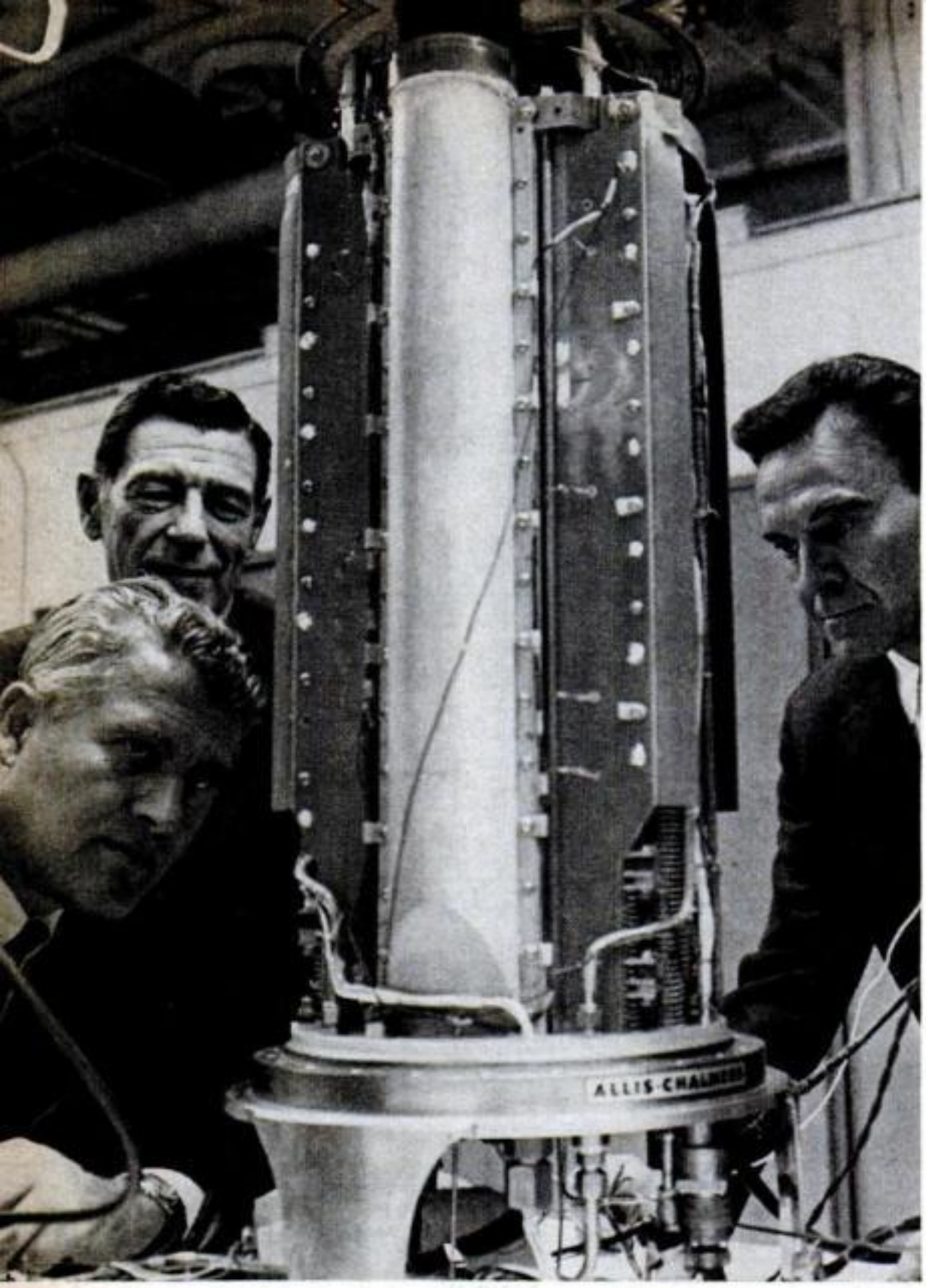

Dr. von Braun, left, inspects new fuel cell for space vehicles. It turns hydrogen and oxygen into 2,000 watts of electricity, plus pure drinking water for astronauts.

So far, from Mercury to Apollo, our program of manned space flight has bypassed a pioneer idea for living in space. Here a noted authority answers the question:

What ever happened to the Manned

By Dr. Wernher von Braun

Director of NASA's George C. Marshall Space Flight Center, Huntsville, Ala.

DURING the years before Sputnik, several writers, including myself, predicted that one of the first objectives of manned space flight would be to establish one or more orbiting space stations.

Today we're busy building rockets and spacecraft to take men to the moon. We have been fabulously successful with Project Mercury, and our Saturn I rockets have shown that they can reliably haul more than 10 tons of payload into orbit. Yet little is heard of manned space stations. Why is that so?

Actually the manned-space-station concept is just as exciting today as it was 15 years ago. There is absolutely no doubt that this country will have one or several such stations in orbit within a very few years. The reason a project for a space station hasn't been pushed more aggressively is simply that we don't know, yet, exactly how to build one best suited to the purposes it will serve.

Gemini to point way. As long as our manned-space-flight experience is limited to a total of about 53 hours logged by our astronauts, we cannot possibly specify the layout of a space station and all its many-faceted equipment in enough detail. Orbital flights by Gemini astronauts, in their two-man spacecraft, soon

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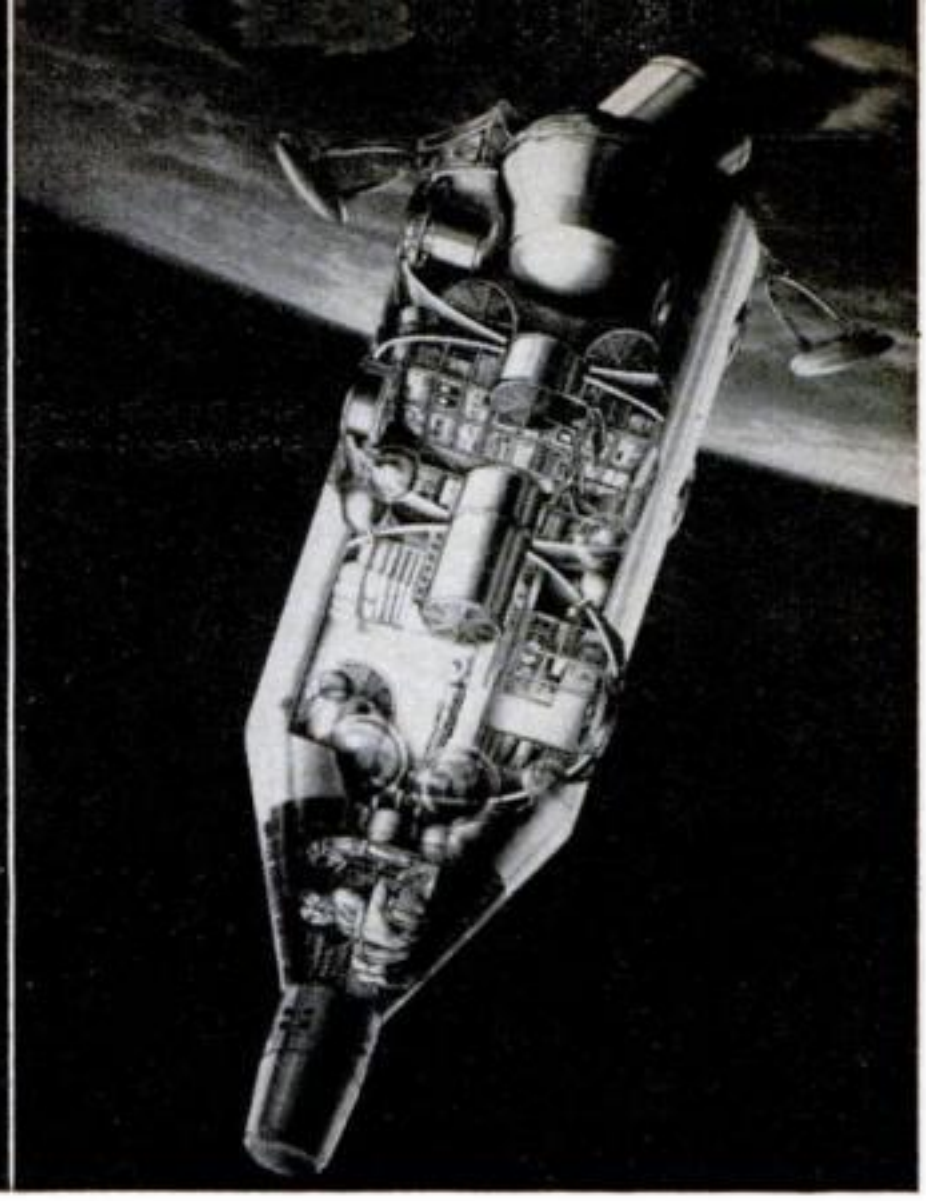

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Wheel-shaped space station was foreseen by Dr. von Braun as early as 1952, in Viking Press book "Across the Space Frontier" from which this painting by Chesley Bonestell is reproduced.

Manned Orbiting Laboratory with two-man crew, currently projected by Air Force, would help develop space-station plans. This design is proposed for it by Lockheed Aircraft Corp.

Space Stations?

will help close this gap in our experience. And, if the Air Force receives a long-awaited go-ahead, so will its Manned Orbiting Laboratory, designed to study man's ability to perform useful military tasks in space.

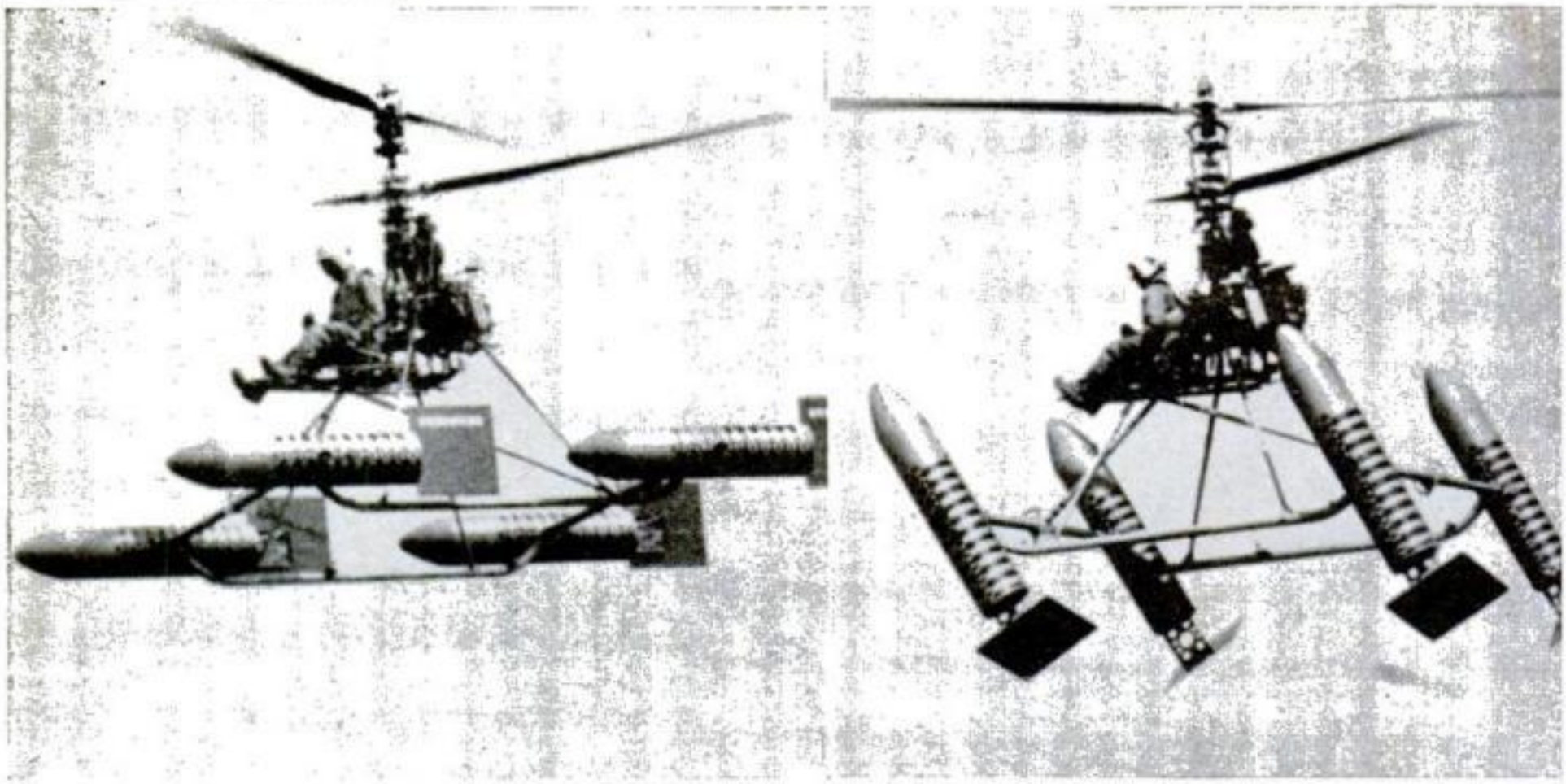
The Gemini astronauts, for the first time, will try orbital rendezvous and docking—a maneuver necessary to the operation of any space station. Inside and outside of their spacecraft, they will perform a whole slew of scientific observations and experiments. All this will give us a better idea of how much more can be accomplished by a manned space station than by an automatic observatory in space.

Using our space stations. Already we can foresee many tasks for which manned space stations can be immensely useful:

- Astronomical and astrophysical studies of sun, moon, planets, and the surrounding universe. Advantages of a space station would be freedom from atmospheric turbulence, and from the filtering effects of the earth's atmosphere on ultraviolet and other radiation.
- Observations of the earth's surface, for many purposes: weather forecasting, storm and flood warning, iceberg patrol, snowfall and water-resource management, prediction of volcanic eruptions and landslides, detection of forest fires, military reconnaissance, and navigational aid for ships and aircraft.
- Physical, medical, and life-sciences research. A space station is the ideal place for research on the effects of a number of conditions impossible to simulate on earth: prolonged weightlessness, space radiation of various types, a near-perfect vacuum of unlimited size.
- Maintenance of complex space in-

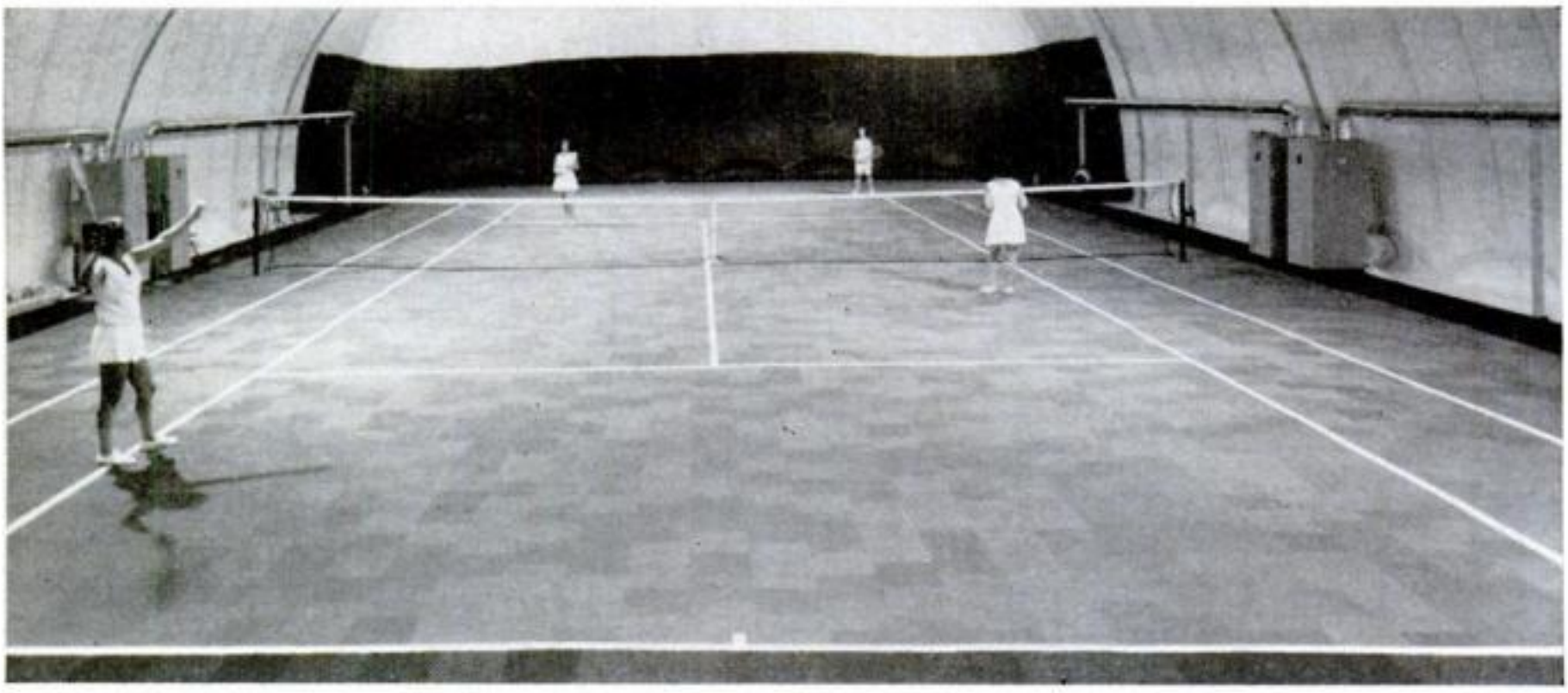
[*Continued on page 234*]

Urheberrechtlich geschütztes Material



Tilt floats let helicopter set down softly on water

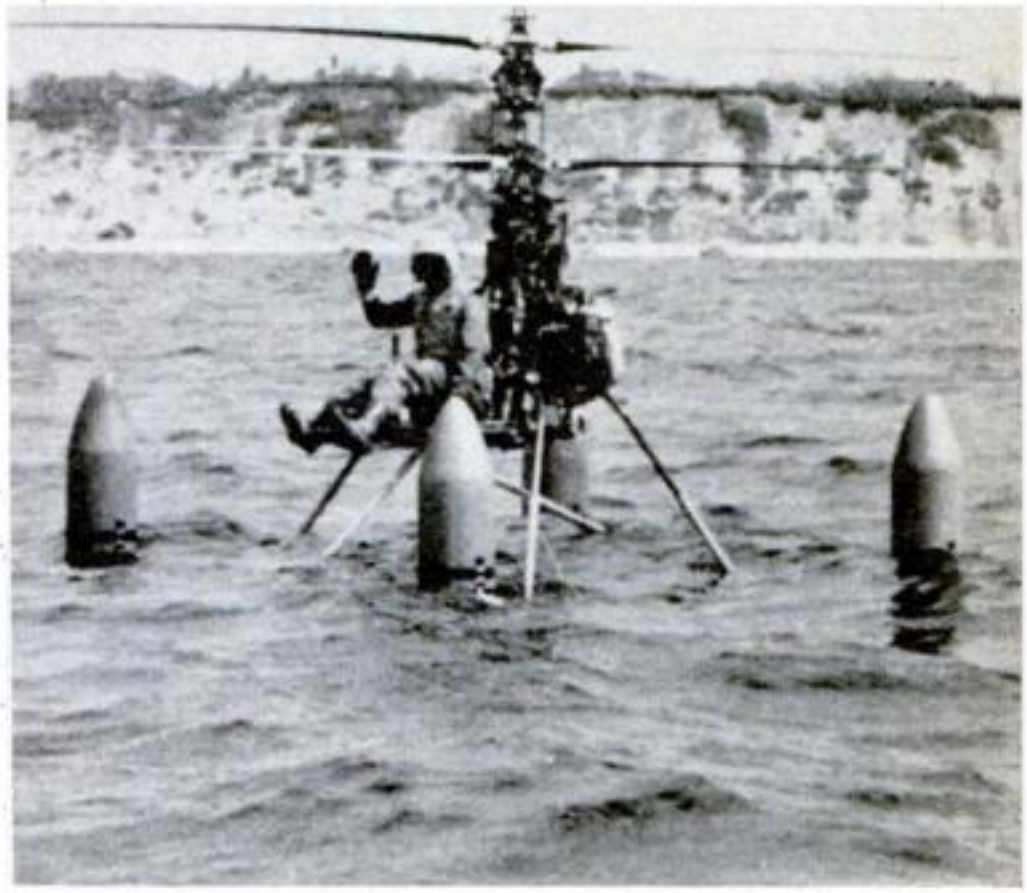
Latest device for sea-rescue work from the air is a set of tiltable floats shown being tested on a small helicopter in the photo sequence above. Pointed forward, the bullet-shaped floats do not interfere with normal flight. When the copter slows down,



Plastic grass for indoor tennis

Plastic floor tiles that look and feel like a carefully mowed lawn are now made for indoor tennis courts, putting greens, patios, and poolside recreation areas. The Neo-Turf vinyl is poured into minutely indented molds. When the plastic is removed after curing, nubs adhere, forming grasslike fibers that stretch to a uniform 3/16 inch. American Biltrite Rubber Co., Cambridge, Mass., makes 12-inch squares in green, 36-inch-long strips in white for markings.

Urheberrechtlich geschütztes Material



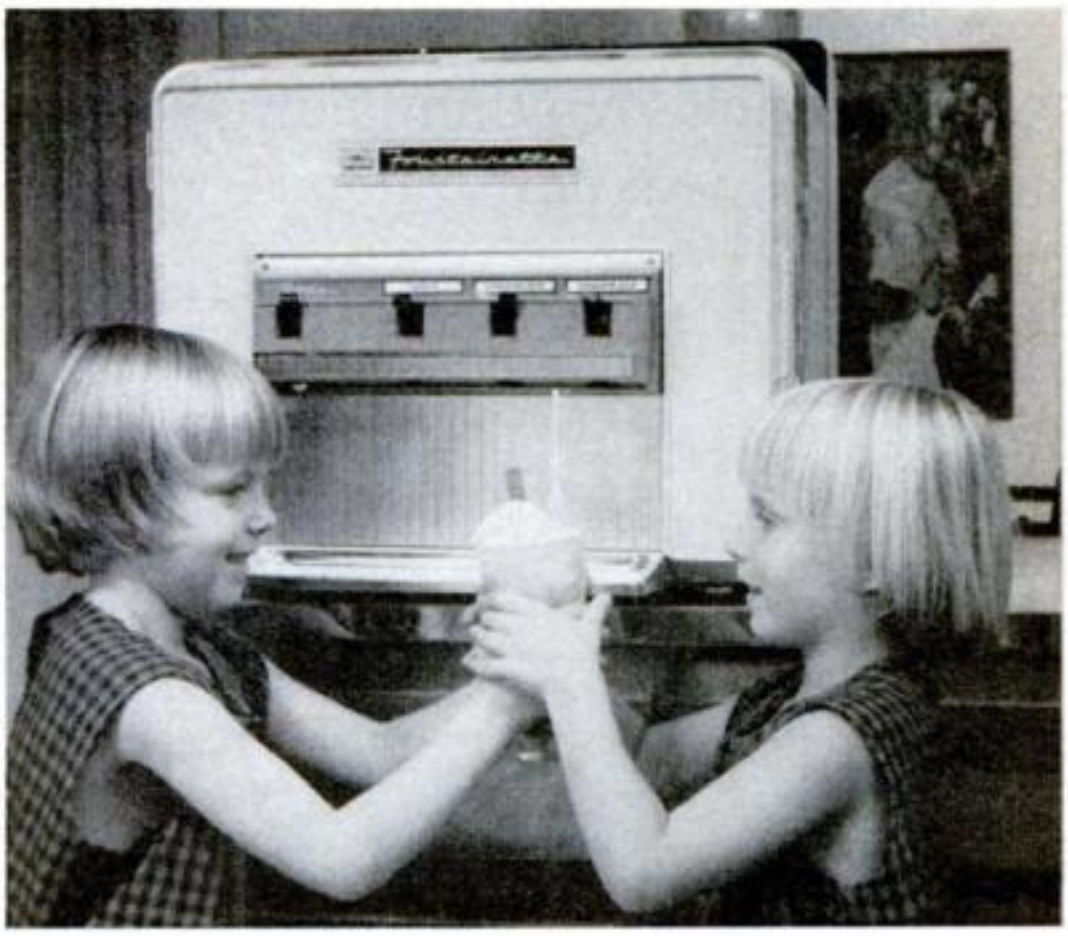
they are angled downward until vertical, for a soft landing on rough water. For take-off, the procedure is reversed.

Vertical floats are more stable in rough seas than pontoons, enable the craft to be held almost stationary while the crew is pulling castaways from the sea. Developed jointly by Gyrodyne Co., St. James, N.Y., and the Navy, the floats are being tested on VTOL planes as well as helicopters.

Spray-on sausage skin

Fed by a mechanical mixer and hopper, this machine produces 180 sausages an hour with one operator. The British invention extrudes the meat, cuts it into lengths, and sprays on skin as sausages pass on a belt.

Skin, a pulverized-vegetable emulsion, is piped through nozzles as sausages leave the extruder. It dries in 30 seconds.



Home fountain makes carbonated drinks

Real ice-cream sodas can be made at home with this table-size fountain. It has four taps, one for refrigerated carbonated water, the others for syrups, and serves 120 drinks with one filling. Bernz-Omatic's Fountainette makes its carbonated water from tap water and a CO_2 tank good for 1,000 drinks. It operates on house current, 12-volt car or boat battery, or propane gas. Cost: about $400.

Urheberrechtlich geschütztes Material

REPORT FROM THE DRIVER'S SEAT

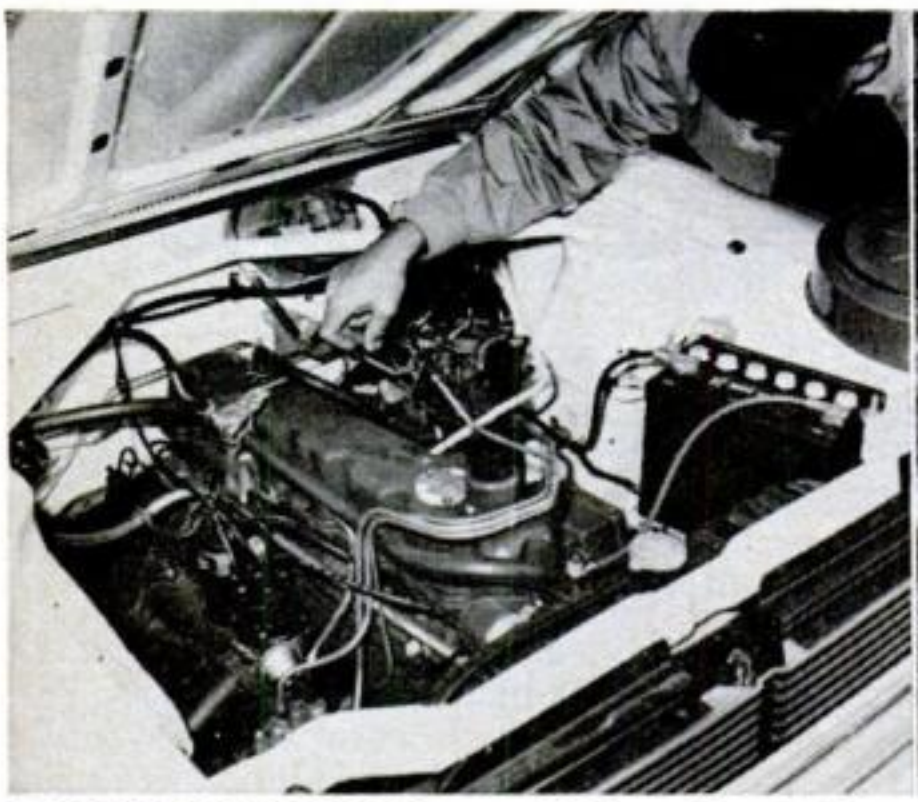
Comparing the Compacts:

Testing the economy champs with their second-generation sixes, PS finds something new has been added: performance

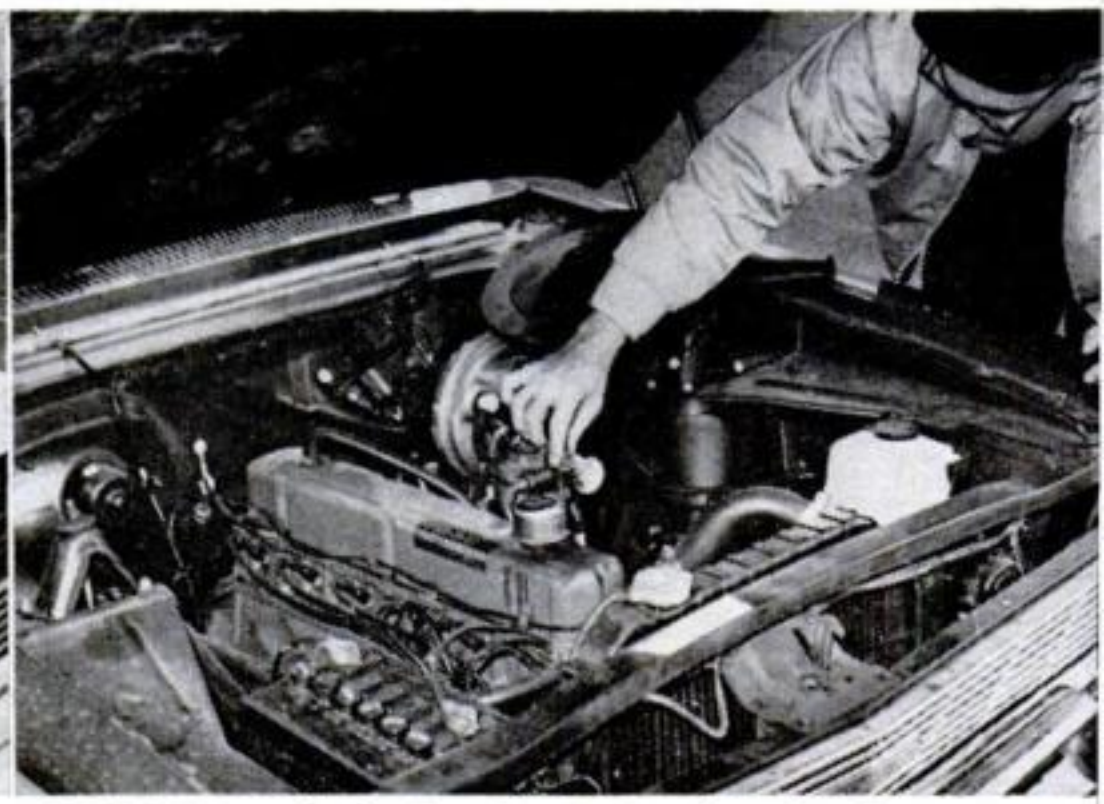
By Jim Whipple

IT WOULD be hard to say who was the more surprised, the driver of the '64 Olds I passed at 70 on a long upgrade, or myself, at the wheel of the new Rambler American six that passed him.

Two days later, I moved through a turnpike tollgate in a '65 Falcon six with



RAMBLER AMERICAN started life with a 90-hp. L-head six, or, as an option, a 125-hp. OHV six. For '65, you can get this smooth 155-hp. job with seven main bearings, another low-cost option.



CHEVY II can be had with a 90-hp. four (underpowered), a 120-hp. six (adequately powered), this 140-hp. six we tested (very good power), or three V-8s from 190 to 300-hp. (overpowered).

Urheberrechtlich geschütztes Material

Four to go: Rambler American 440, Chevy II Nova, Valiant 200, and Falcon Futura. All had automatic transmissions. After wringing them out at the track, we drove each one 350 miles on all kinds of roads.

AMERICAN·CHEVY II·VALIANT·FALCON

late-model 300-plus-cubic-inch V-8s on either side. The drivers of the big ones took off with solid blasts but were amazed to find my Falcon hanging alongside as we all reached 65 m.p.h. together.

Incidents like these will occur all over the country as more and more U.S. drivers discover that there is a new breed of six-cylinder compact around that no longer behaves as if powered by the mechanism of a tired Swiss cuckoo clock.

What's more, you can save while you swing because any one of the "little four" can still pull away from the gas

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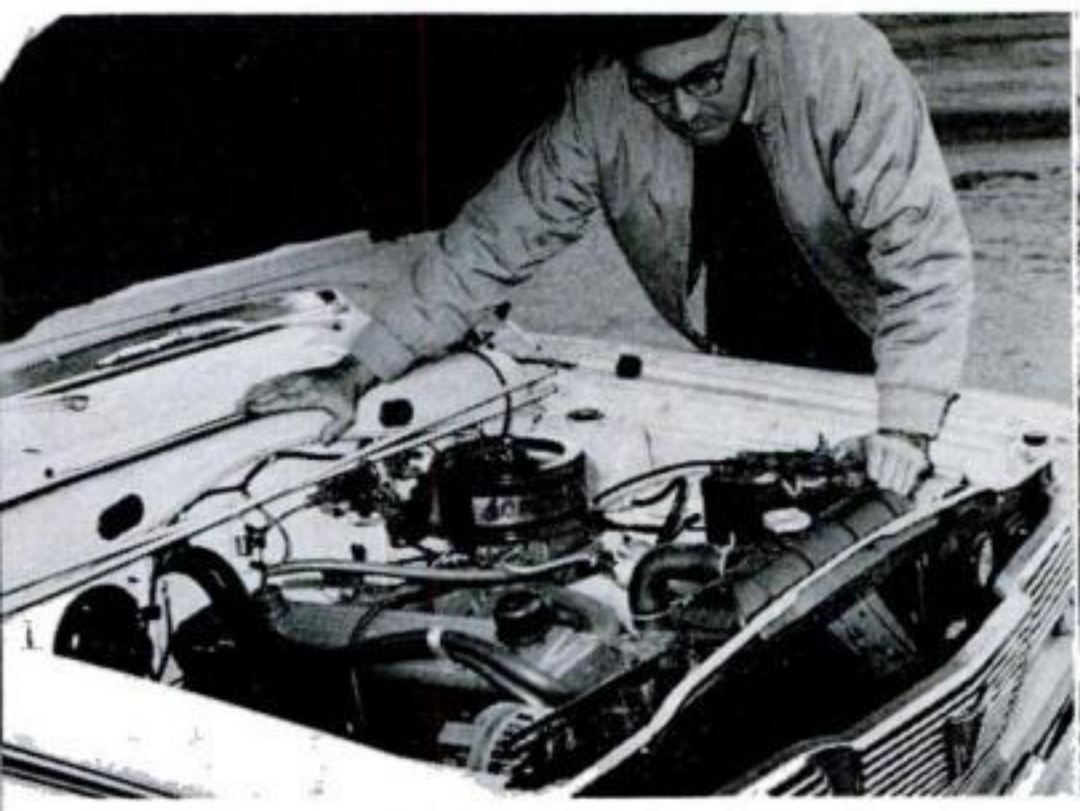


VALIANT offers its original 101-hp. slant six, a 145-hp. version of the same engine, (it has one-inch longer stroke), or warm and hot versions of a 273-cu.-in. V-8, new last year.

FALCON was in dire need of the shot in the arm given its performance by this new, seven-main-bearing six of 120-hp.; other engines are 101-hp. six (four main bearings) or 195-hp. V-8.

Urheberrechtlich geschütztes Material

RAMBLER AMERICAN handles well in strictly ordinary driving over good roads. However, when pushed hard over indifferent to bad roads, it plunges and wallows, tends to lose its directional control quickly.

CHEVY II is at its best when belting down good roads at 70 plus m.p.h., and its best is very good. In ride and handling on lumpy, crowned back roads, it ranks after the Valiant.

pump leaving plenty of stuffing for your piggy bank.

In performance, these hot-six compacts equalled the standard-size cars (Ford, Chevy, and Plymouth) equipped with the small V-8 engines [see PS, Dec. '64]. Chevy II and Valiant just about matched their big brothers, the Chevrolet Impala and Plymouth Fury, with 12.7 and 12.2 seconds to 60 m.p.h. compared with the bigger cars' 12.8 and 12.1 seconds.

To give our big-six compacts a thorough shakedown, we took them to the Lime

RAMBLER AMERICAN has good seating position and extremely comfortable bucket seats on the hardtop. All front-seat backs adjust.

CHEVY II has no-nonsense style that permits plenty of headroom for tall man even in rear seat of hardtop, usually the lowest roofed.

VALIANT has the best trunk, thanks to some clever engineering that sinks the spare into a floor well. Tank is contoured to clear it.

FALCON got a new roof and outer sheet metal in '64, but still retains the body shell introduced in 1960. Cramped rear compartment is a result.

VALIANT is without doubt the handling star of this group in rough going. Only Chevy II comes close in ride. Valiant's comfort nears that of the intermediate-size cars.

FALCON with its new power team of 120-hp. six and Cruise-O-Matic would be a good long-trip car if the ride and the driving position were more comfortable. Wind roar at 70 m.p.h. is very tiring.

Rock, Conn., track for performance testing with our fifth wheel.

The Chevy II. Though handicapped by Powerglide transmission which, with its lack of intermediate gear, dumped the car from low to direct ratio at 45 m.p.h., the Chevy II gave reasonably powerful performance. The 230 engine is a good, solid, smooth job. It pulled nicely. With manual three- or four-speed, or a good three-speed automatic, the engine would be a fine power plant for a car of this weight and size. It's definitely the best engine for the Chevy II with Powerglide.

The car is well built and tight, and vision is good. Instrumentation is minimal, but can be read with ease, night or day, at a glance. Steering is good. The car handled as well as any of the four at average or slightly above average speeds on all kinds of highways. It's a stable car—better than the Falcon in ride, considerably better than the Rambler American, and very close to the Valiant.

I found the driving position best in the Chevy II, with Valiant dropping a shade behind due to the seating angle. Chevy II has a firm seat with plenty of support. Leg positioning is good, although I (being tall) could use an extra inch or so of legroom.

The Chevy II trunk is sizable though not as big as Valiant's. The body is the most solid of the four cars—tremendously solid for a hardtop. Noise level is satisfactorily low—except when you are forced to downshift and use low gear in the two-speed automatic; there's lots of noise at high revs.

The Falcon. The 200-cu.-in. engine has done a lot for the Falcon. That tinny roar, which had always come with full-bore acceleration, has almost vanished. The new seven-main-bearing engine is much smoother and quieter in spite of higher power. For the first time since the car was introduced in 1959, Falcon-six owners can get out and run with the pack.

The body is really tight—no rattles or reverberations. Exhaust and engine noises are way down to big-car level—quite acceptable.

The basic limitations of the Falcon are those imposed by its body shell. I find the seat too low and the angle of the seat back too acute. It keeps you in a jackknife position—back forward and thighs too far up. Compounding this, the wheel is still a bit too close even after being moved forward last year; it could still happily go forward another inch to accommodate long-armed drivers.

The Falcon feels a bit unsteady on its wheels on some back roads. Things get bouncing as you corner fast, and you have a feeling that the car isn't going to dig its feet in. The ride seems "busy." However, the car isn't dangerously unstable, and the ride isn't rough enough to chop you unhappily.

CONTINUED

Urheberrechtlich geschütztes Material

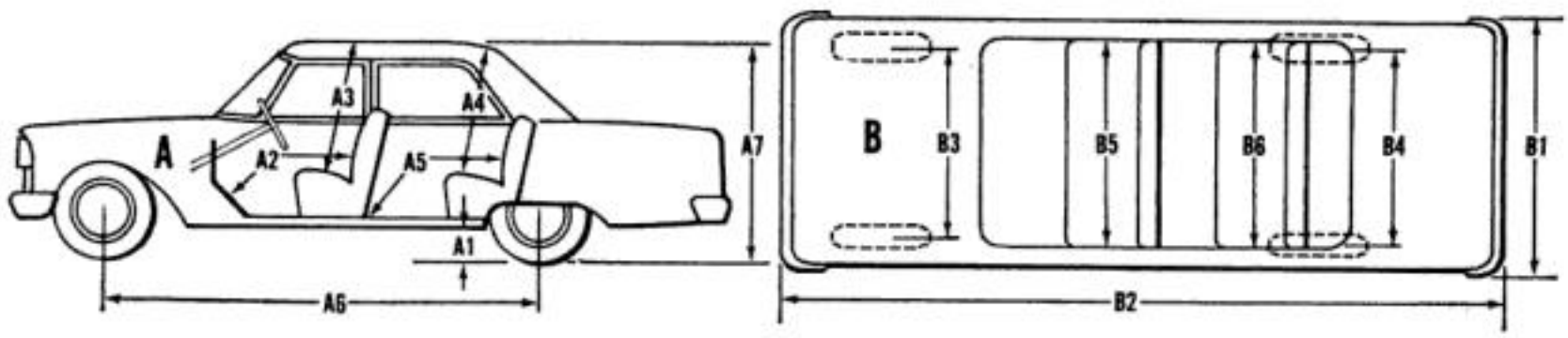
Upholstery is both firm and well made on this top-of-the-line Futura. Everything works well; all latches and switches do the job they were designed to do. The heater blower is noisy but effective. The trunk is adequate, but its high lip makes for difficult loading. The car handled well in traffic.

The Rambler. I liked the bucket seats; they give excellent support under the thighs. But adjustment of the backs is not fine enough—you sit either bolt upright or too far back.

Vision is good, but the wheel is a bit too close. Here's another compact that could use an adjustable steering column like Corvair's. If the seat could go back an inch and the wheel go forward, I'd be very happy in this car. The hood is short and rounded off; you get a good idea of where the car is in a traffic lane. Steering is slow, yet fairly precise. You can hold the car where you want it. However, on a sharp-curved road at high speeds, you've got to wind it a bit too much.

The instrument panel is mediocre, with heater controls scattered all over. Wiper coverage is good. Throttle linkage is sticky and jerky in action. You squeeze down on the pedal, and suddenly the

[*Continued on page 198*]



DIMENSIONS (inches)	CHEVY II Nova	FALCON Futura	RAMBLER American 440	VALIANT 200
A1 Ground clearance	5.2	5.9	6.0	5.5
A2 Front legroom	40.1	42.0	41.0	39.9
A3 Front headroom	39.0	38.8	38.8	38.2
A4 Rear headroom	37.6	37.1	37.0	37.2
A5 Rear legroom	36.1	34.1	36.5	35.0
A6 Wheelbase	110.0	109.5	106.0	106.0
A7 Overall height	55.0	54.5	54.5	53.5
B1 Overall width	69.9	71.6	68.6	70.1
B2 Overall length	182.9	181.6	177.2	188.2
B3 Front tread	56.8	55.0	56.0	55.6
B4 Rear tread	56.3	56.0	55.0	55.6
B5 Front seat width	59.2	57.1	57.2	56.9
B6 Rear seat width	58.9	56.6	57.1	57.0

SPECIFICATIONS

Engine type	OHV six	OHV six	OHV six	OHV six
Bore & stroke	3.875x3.25	3.68x3.13	3.75x3.50	3.40x4.125
Displacement	230 cu. in.	200 cu. in.	232 cu. in.	225 cu. in.
Compression ratio	8.5:1	9.2:1	8.5:1	8.4:1
Carburetion	1 1-bbl.	1 1-bbl.	1 2-bbl.	1 1-bbl.
Fuel grade	Regular	Regular	Regular	Regular
Horsepower	140 @ 4,400	120 @ 4,400	155 @ 4,400	145 @ 4,000
Torque	220 @ 1,600	185 @ 2,400	222 @ 1,600	215 @ 2,400
Transmission	Powerglide 2-speed & torque converter	Cruise-O-Matic 3-speed & torque converter	Flash-O-Matic 3-speed & torque converter	TorqueFlite 3-speed & torque converter
Axle ratio (std.)	3.08:1	2.83:1	3.31:1	3.23:1
Steering ratio—manual	25.4:1	27.0:1	29.0:1	28.7:1
Steering ratio—power	25.4:1	22.0:1	21.2:1	18.8:1
Brake-lining area (effective)	168.9 sq. in.	131.0 sq. in.	153.7 sq. in.	153.5 sq. in.
Curb weight	2,770 lb.	2,510 lb.	2,716 lb.	2,690 lb.
Price at factory	$2,469	$2,403	$2,452	$2,426

All specifications for four-door sedans. Prices include Federal tax, automatic transmission, and radio

PERFORMANCE

0-60 m.p.h.	12.7 sec.	13.5 sec.	11.3 sec.	12.2 sec.
0-80 m.p.h.	25.7	30.6	20.5	25.8
40-60 m.p.h.	8.1	8.2	6.5	7.0
50-70 m.p.h.	9.2	10.2	8.7	9.8
SS ¼-mile	20.0	19.1	18.0	18.6
Overall fuel mileage	18.8 m.p.g.	23.8 m.p.g.	17.7 m.p.g.	19.0 m.p.g

Urheberrechtlich geschütztes Material

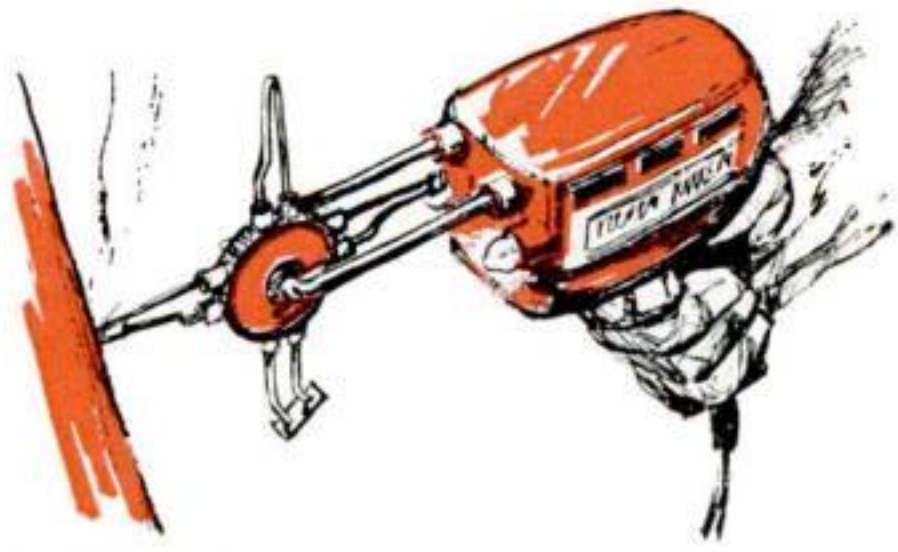
"I'd like to see them make..."

Built-in windshield covers in roofs of cars. A weighted bottom would hold the cover over the glass to keep off snow in winter when parked all day.—*Richard Rodack, Pittsburgh, Pa.*

An electric paint sprayer that would fit any quart paint can. When emptied, you'd throw away the can and only have to clean the spray nozzle.—*Paul T. Young, Greenfield, Ind.*

Screw-out latches that need no resetting if a door shrinks. You'd just rotate the latch until it engaged the striker properly to keep the door closed.—*R. Pasterczyk, Wilmette, Ill.*

A plug-in thermoelectric cold pad filled with a coolant. It would replace the usual ice bag that must be constantly refilled as the ice melts.—*Mrs. E. Miller, Lansing, Mich.*



Multitip soldering guns with turret-mounted rotating tips to eliminate bothersome interchanges during a job. Only the tip in use would heat up.—*David Haase, Baton Rouge, La.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's *yours?* We will pay $5 for each one published. Please use Government postcards only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 10017. Write your name and address clearly. Contributions cannot be acknowledged or returned.

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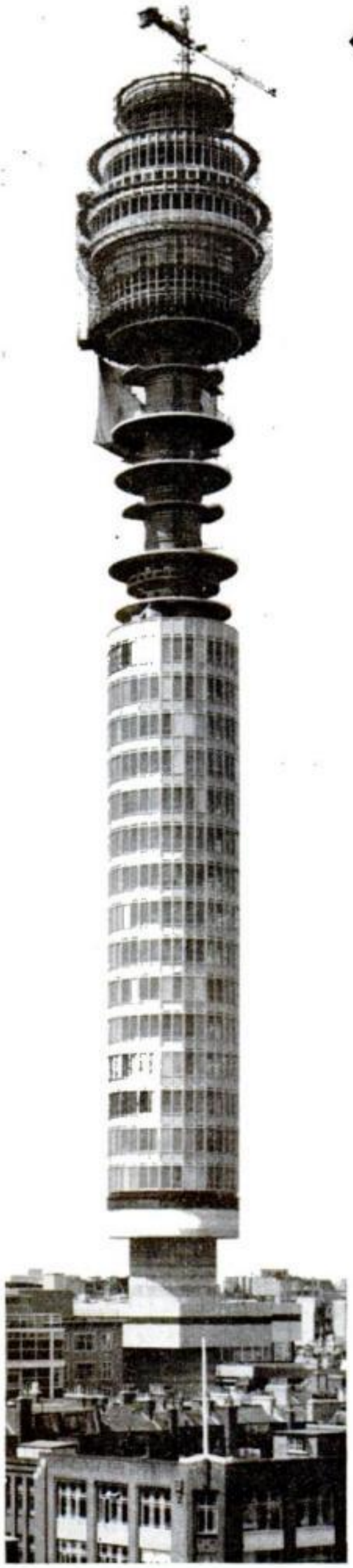
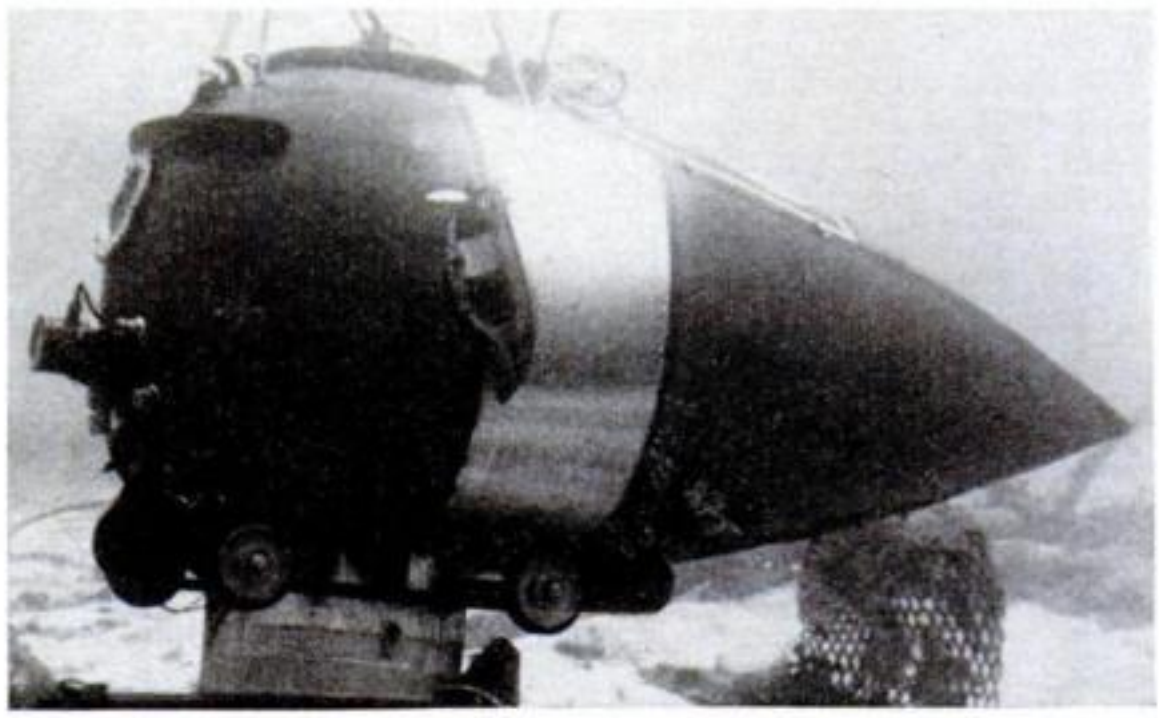


TV tower is London's tallest building

The 620-foot British Post Office tower has microwave links for 40 TV channels, with open galleries containing horn and disk aerials in a circular omnidirectional complex. Its hollow concrete shaft is designed to lean no more than a third of a degree in a 90-m.p.h. wind.

Also housed are telephone installations for 150,000 simultaneous conversations, storm-warning radar, and fog recorders. At 515 feet, there is a revolving restaurant.



Research submarine doubles as diving bell

Resting on a submarine-hatch mock-up off Bermuda, a nine-foot nonmilitary research vessel shows how it could assist in underwater rescues. Similar but larger vessels, says General Dynamics, could be air-lifted to the scene, be quicker than diving bells in evacuating the crew of a stricken submarine.

The self-propelled one-man Star I was built for locating and attaching itself to objects under water. The operator sits in its pressurized cabin as if driving a car. Batteries or fuel cells power its two engines.

Skaters' pusher: all play, no work

The rear skater in the quintet at right furnishes locomotion—the others just go along for the ride.

Strapped to his back is a homemade air propeller powered by a lawn-mower motor. The blade of the pusher fan whirls in a protective wire frame.

Introduced on Como Lake, St. Paul, Minn., it can do 30 m.p.h.—without extra riders.

Urheberrechtlich geschütztes Material

Boats and Boating

24 pages about hulls, trailers, piers, floats, boathouses, boat handling, stern drives, outboards, marine electronic equipment, and much more . . .

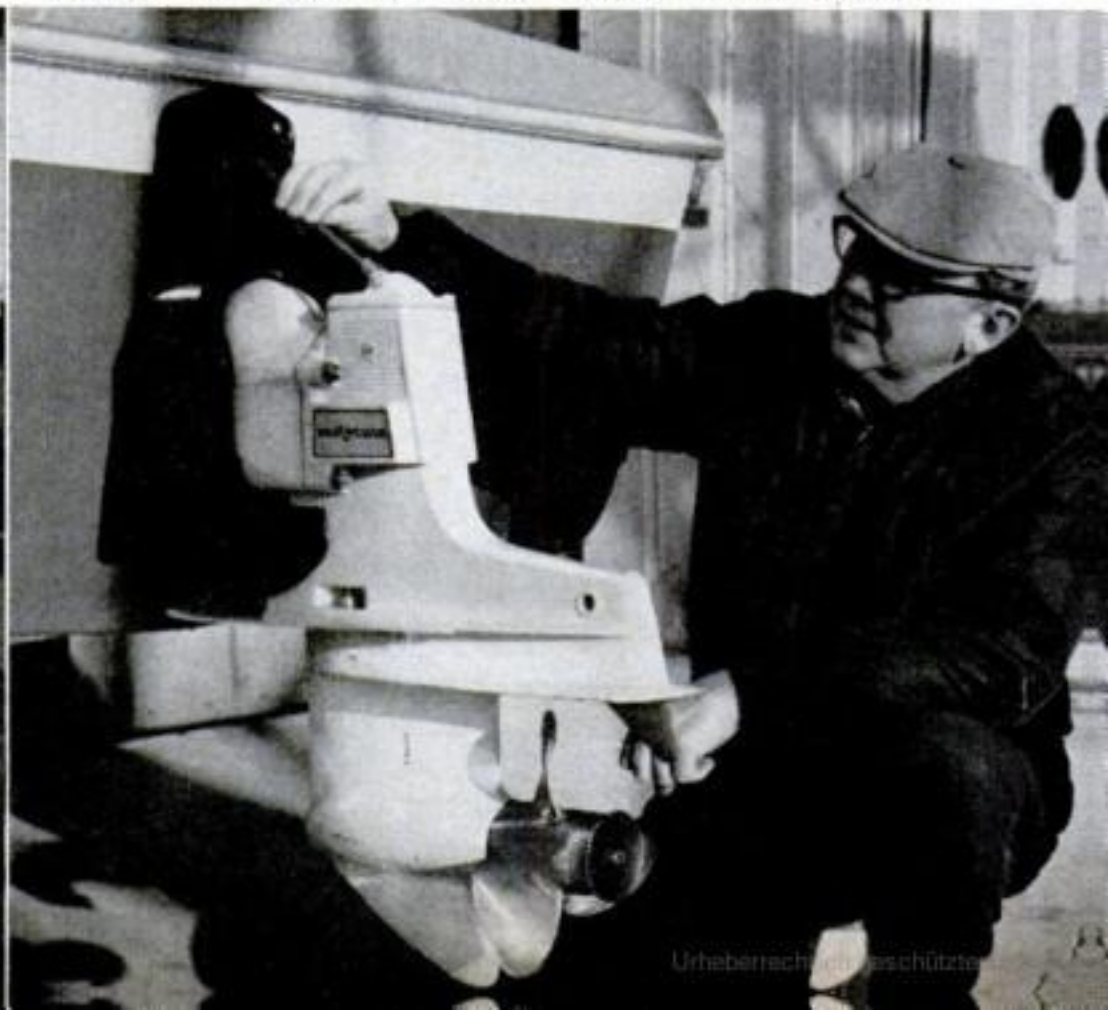
New Mercury small-boat stern drive · 100
Tips for better outboarding · 103
Building piers, floats, and boathouses · 104
How hulls are made · 108
What's new in boating for '65 · 112
Building a light boat trailer · 116
How to dock and depart with dignity · 118
Going down to the sea with your ship · 122

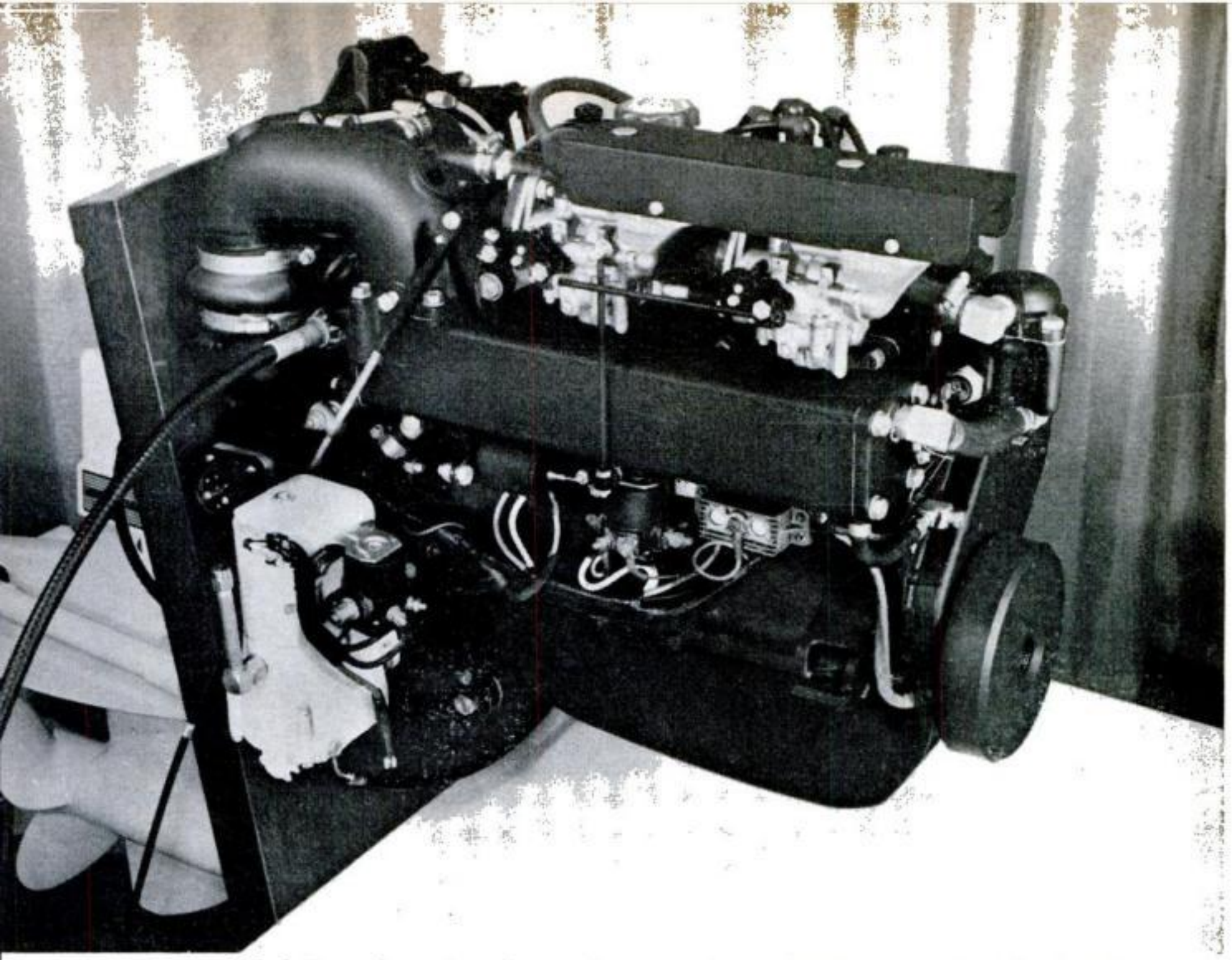
New MerCruiser 60 slices chilly Wisconsin water in PS pre-announcement test.

New small-boat stern drive:

Transom-hung motor extends only 24 inches forward into boat. And it's narrow enough so that handy stern seats can be fitted at each side, giving a runabout more "people room."

New small-size stern-drive unit has many big-Merc features: crank-up or power tilt; through-hub exhaust; hydraulic shock absorbers. Water pump is mounted just inside top cover.





Marine-modified Renault engine shown above requires only six connections for installation.

MERC GOES MINIATURE

By Jim Roe

NOW almost any boatsman can "go stern-drive." The brand-new Model 60 MerCruiser, smallest production stern drive made anywhere, is designed to power craft as small as 14-footers.

A shrunk-down version of the big MerCruisers? Not at all. While the Model 60 has many of the features of its bigger brothers, a second look will show you that it has its own bag of tricks.

To give you a close look at this newly hatched power plant, POPULAR SCIENCE gave it an exclusive pre-announcement test at MerCruiser's proving ground.

Before leaving the testing dock, I saw what Mercury engineers have done to design what they claim is the world's smallest production stern-drive power package.

They've taken a basic 67.6-cu.-in. four-cycle, four-cylinder engine, modified it to meet marine propulsion requirements, and direct-coupled it to a new small-size stern-drive unit. Unlike more powerful models, this entire assembly—the outdrive unit to the rear of the transom and the engine forward of it—is suspended entirely on the transom. This Dyna-Focal suspension uses four soft-rubber aircraft-type mounts.

There is not a single belt in the entire unit. A direct-drive permanent-magnet alternator is mounted on the front end of the crankshaft. The generator has no brushes and no commutator, eliminating the fire hazard of brush-sparking.

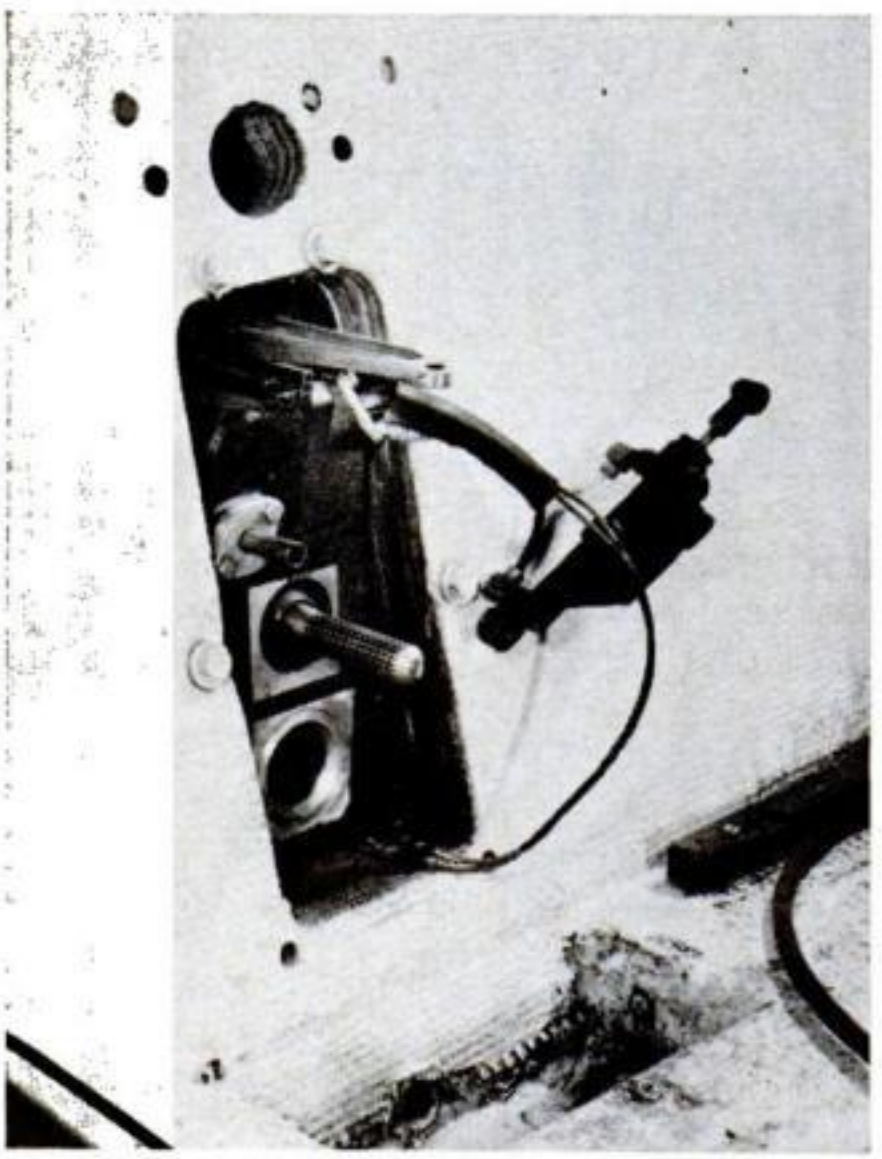
The new stern-drive unit has the typical family features: through-hub exhaust; crank-up or optional hydraulic tilt; splined-to-the-shaft propeller with no shear pin. The

CONTINUED

Urheberrechtlich geschütztes Material

SPECIFICATIONS
MERCRUISER MARINE 60

Horsepower	60
Engine r.p.m., continuous duty	4,500
Bore	2.76 in.
Stroke	2.83 in.
Piston displacement	67.6 cu. in.
Compression ratio	8.5:1
Firing order	1-3-4-2
Main bearings	5
Valves	Overhead
Valve lifters	Mechanical
Carburetion	Dual
Prop reduction ratio	1.64:1
Propeller-pitch range	8 to 17 in.
Maximum propeller diameter	11 in.
Installation length (forward) from transom	23⅝ in.
Max. engine height (above crankshaft)	15¾ in.
Max. engine depth (below crankshaft)	6⅛ in.
Max. engine width	17⅝ in.
Minimum distance for dual engine	28 in.
Engine suspension	Aircraft-type, four-point rubber (Dyna-Focal)
Generator (alternator)	12-volt, 150-watt, direct-drive



Four bolts secure stern-drive unit to transom: four more hold engine to stern-drive unit. Transom is sandwiched between. Engine can be removed without disturbing stern drive. Only one major mounting hole through the transom is needed. View is from inside boat.

cold-water feed pump is located at the top of the stern-drive unit, just inside the top cover. This provides easy access for service. A hydraulic shift system utilizes a sending cylinder on the inner transom plate, a receiving cylinder in the drive unit.

When transom-mounted, the unit takes no more space than an average outboard motor with a drain well. I took a yardstick to check the official figure for installation length forward from the transom: It's less than 24 inches. And with the engine attached directly to the transom, the weight of the engine and the stern-drive unit essentially counterbalance one another.

MerCruiser engineers told me the power plant has enough get-up-and-go to speed 14- to 18-foot boats along at from 27 to 40 miles an hour. At this speed, tests have shown that the engine burns about five gallons an hour. At cruising, fuel consumption is three gallons. Since the engine is a standard four-cycle, there is no mixing of oil and gasoline. To try it out, we took off at a full-bore 5,000 r.p.m.

Pickup and power. My first reaction was that we had a lot more zip than I had expected from 60 horses. Pickup: perfect. Power: plenty. We flattened out on plane and cruised along from wave top to wave top with enough speed and spray to satisfy anyone. The only mishap was when the twin carburetors iced up and stalled us. But this did not happen again after engine heat had built up inside the engine housing.

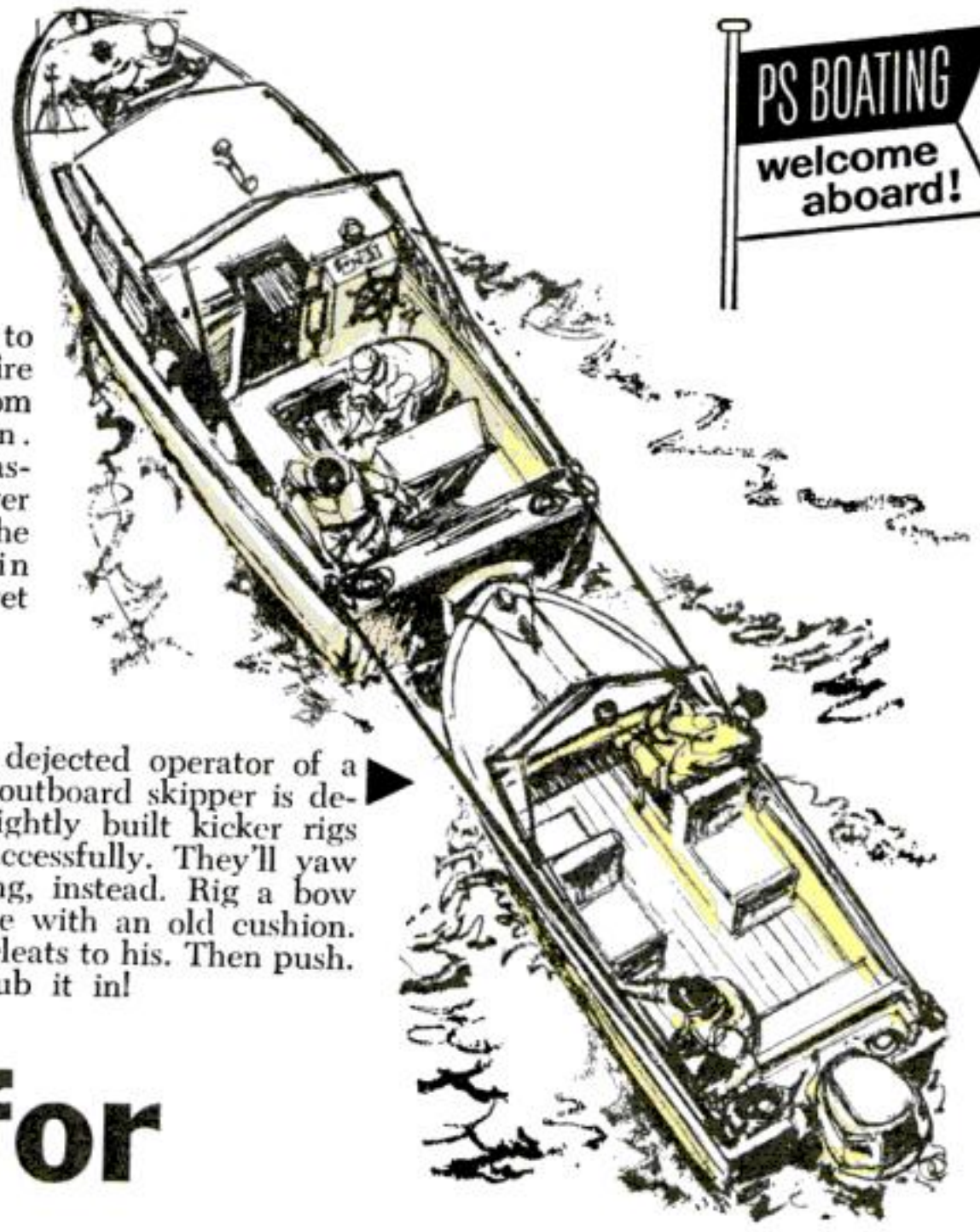
Surprisingly, I had the most fun during the test with the drive unit in reverse. I repeatedly backed down at speed. This is not a healthy thing to do with the normal small boat having a cut-down transom. You may get wet clear up to your hat. So it was a pleasure to see the oncoming waves bounce off the high transom.

Why a stern-drive unit for boats as small as 14-footers? First of all, lots of people like the feel of a stern-drive boat. They like the balance of the inboard engine and the easy maneuverability of the outboard drive. They also like that full-height transom.

These, and all the other reasons why the big stern drives are so popular [see "New Stern Drives Are Red-Hot," PS, Jan.] are the reasons why this new baby brother is apt to become a popular member of the stern-drive family. Any collection of machinery that makes a frigid winter test so much fun is bound to be mighty appealing come May. ■ ■

Urheberrechtlich geschütztes Material

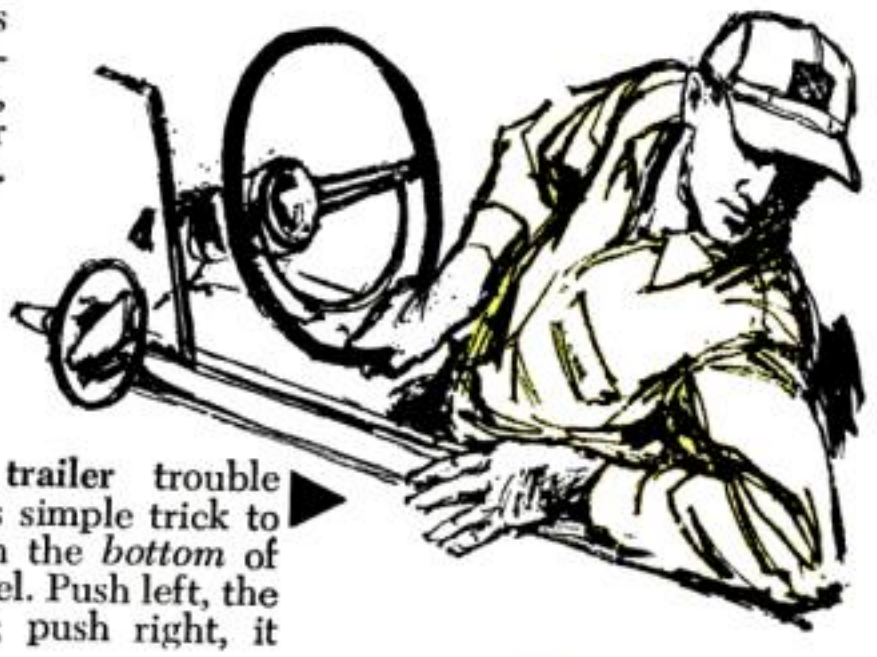
1 Waterproof it, to protect your fire extinguisher from salt corrosion. Simply slip a plastic freezer bag over it. Helps keep the extinguisher in working order, yet easily accessible.



2 Asked for a tow by the dejected operator of a stalled inboard, many an outboard skipper is delighted. But don't try it. Lightly built kicker rigs can't tow heavy inboards successfully. They'll yaw all over the bay. Try pushing, instead. Rig a bow bumper, tugboat style—maybe with an old cushion. Run lines from your quarter cleats to his. Then push. Toot like a tugboat, too! Rub it in!

5 Tips for Better Outboarding

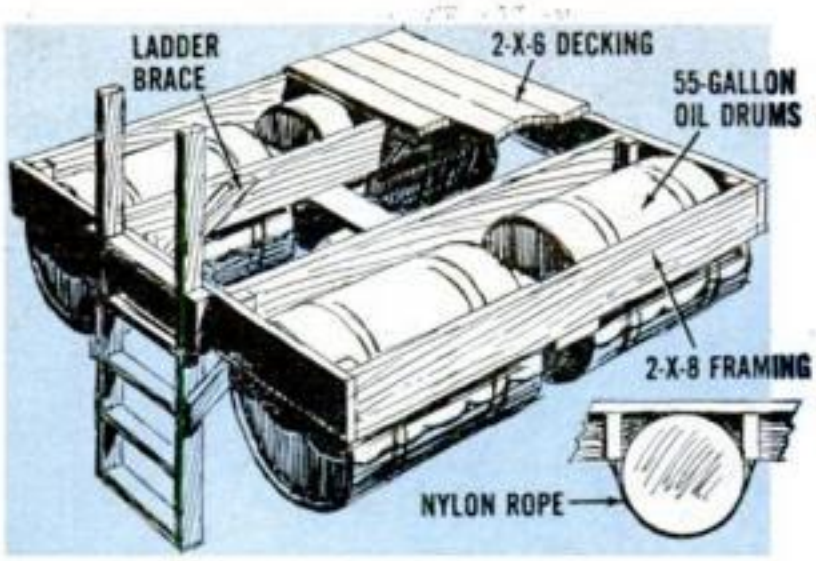
3 Remember always to adjust low-speed carburetor jets while the boat is actually running at low speed. Otherwise, you may build in a tendency for stalling when you shift gears.



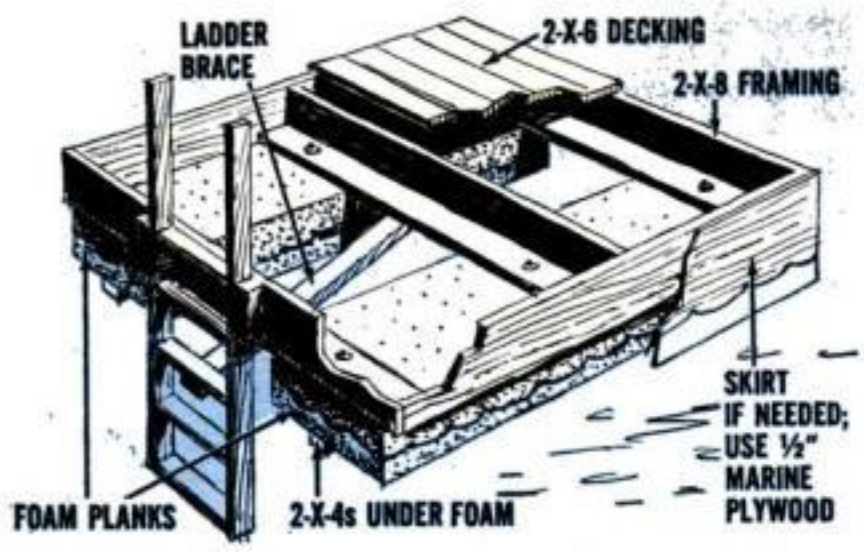
4 Backing a trailer trouble you? Try this simple trick to back: Steer with the *bottom* of the steering wheel. Push left, the trailer goes left; push right, it goes right.

5 Make your own easy-to-use book of charts. Cut charts into pages to fit a three-ring binder. Makes the charts easy to store, handy for use.

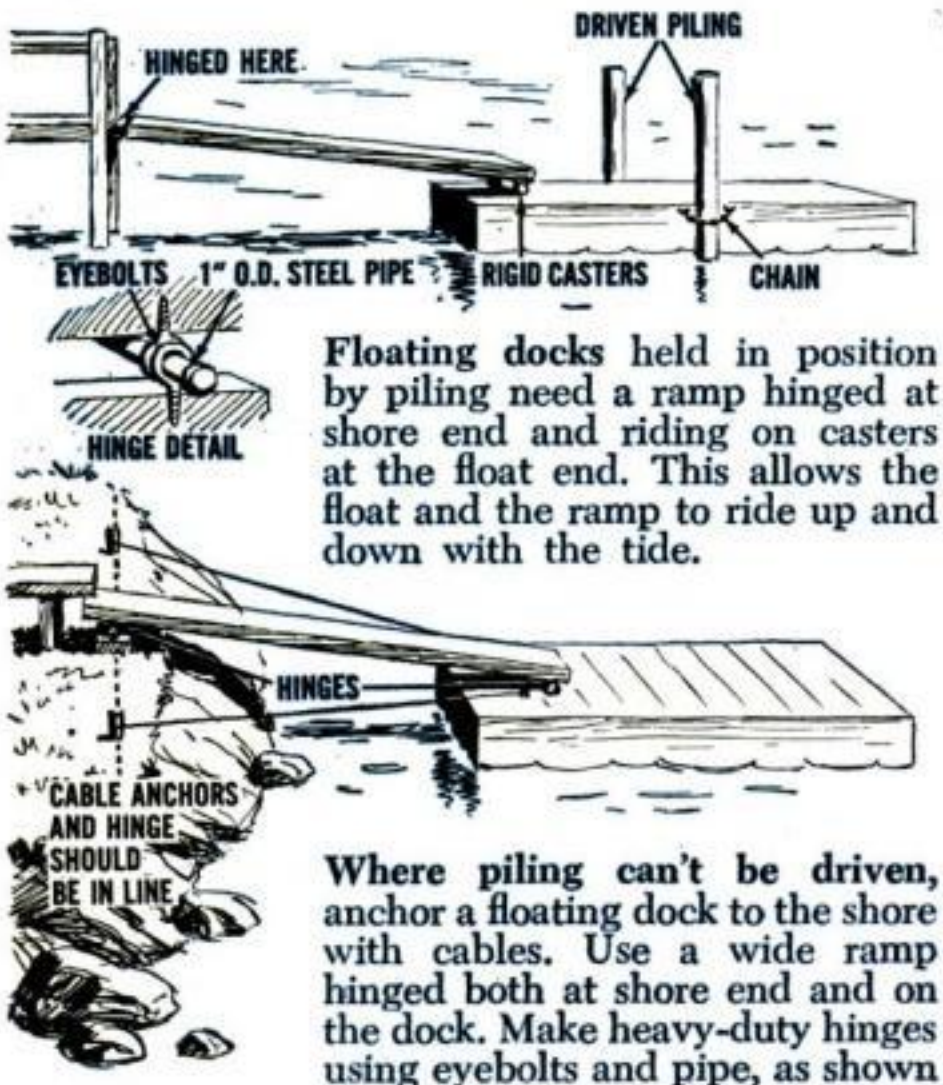
Urheberrechtlich geschütztes Mate



Four 55-gallon oil drums will provide about ¾-ton support for a small swimming float. Drums fit snugly between the two-by-eight framing members. They may be tied in with nylon rope where the water is likely to be choppy. Steel drums will last about four years if kept painted; galvanized about eight.

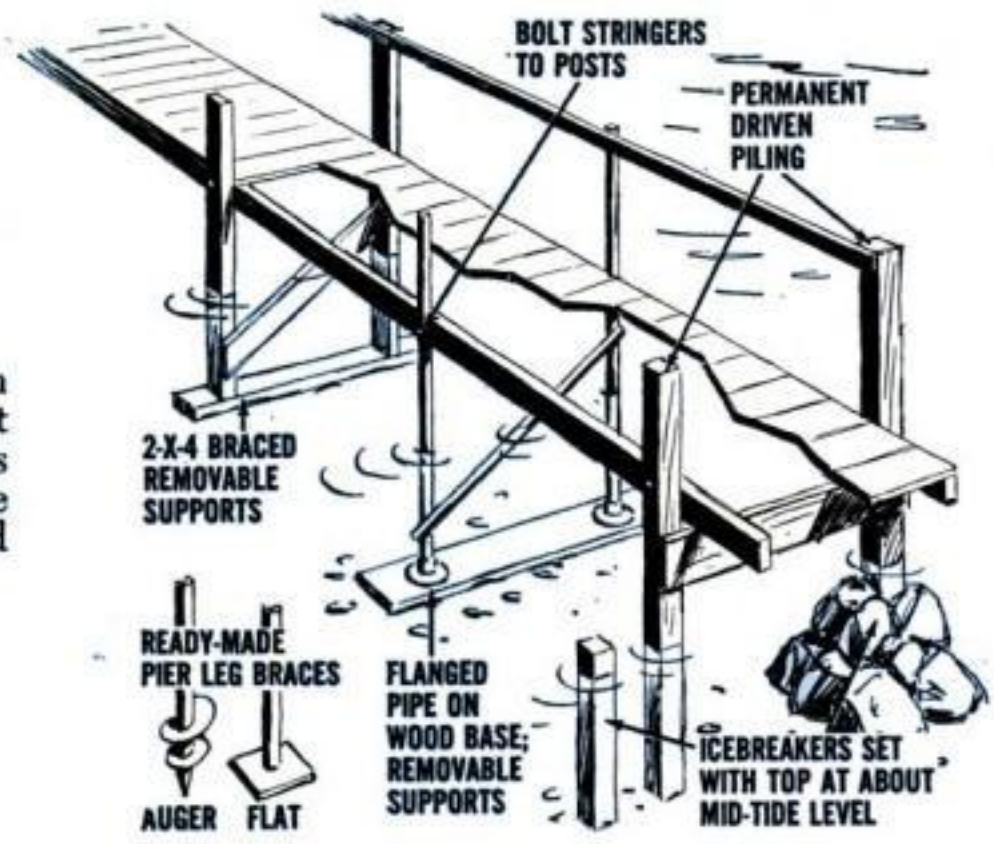


Two "planks" of polystyrene 10" thick, 22" wide, 9' long, will give about the same support as drums. Use two-by-fours under the foam. Run fastening bolts through these, the foam, and the framing members. Cover the foam with wire mesh if you're troubled with muskrats. A wooden skirt will protect the foam from oil.



Floating docks held in position by piling need a ramp hinged at shore end and riding on casters at the float end. This allows the float and the ramp to ride up and down with the tide.

Where piling can't be driven, anchor a floating dock to the shore with cables. Use a wide ramp hinged both at shore end and on the dock. Make heavy-duty hinges using eyebolts and pipe, as shown in detail sketch above.


BOLT STRINGERS TO POSTS
PERMANENT DRIVEN PILING
2-X-4 BRACED REMOVABLE SUPPORTS
READY-MADE PIER LEG BRACES
AUGER
FLAT
FLANGED PIPE ON WOOD BASE; REMOVABLE SUPPORTS
ICEBREAKERS SET WITH TOP AT ABOUT MID-TIDE LEVEL

Driven piling should be protected with penta solution or creosote. Where tidal water ices in winter, use icebreakers such as a pile of rocks or short piling about mid-tide height to break up ice as the tide falls. Removable supports can be made as shown, or bought ready-made with auger-bit tip or flat base.

How to Build PIERS,

By George Daniels

IF YOU have a vacation spot on boating water, the fun really begins when you add a dock or float. No more trekking over a rocky bottom to get a swim—just hop off a smooth deck. And step into your boat as easily as you do into your car—no beaching, no boulder-bumping.

You can build your own pier from scratch for less than $50, buy a ready-made, fit-together 20-footer on steel legs for about $100, or a floating job the same length for around $150. From there on, it's up to you.

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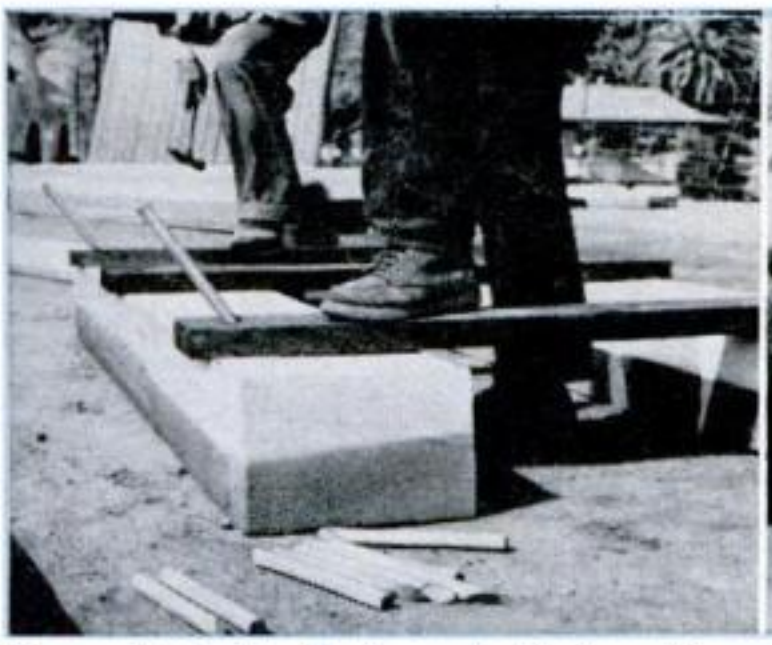
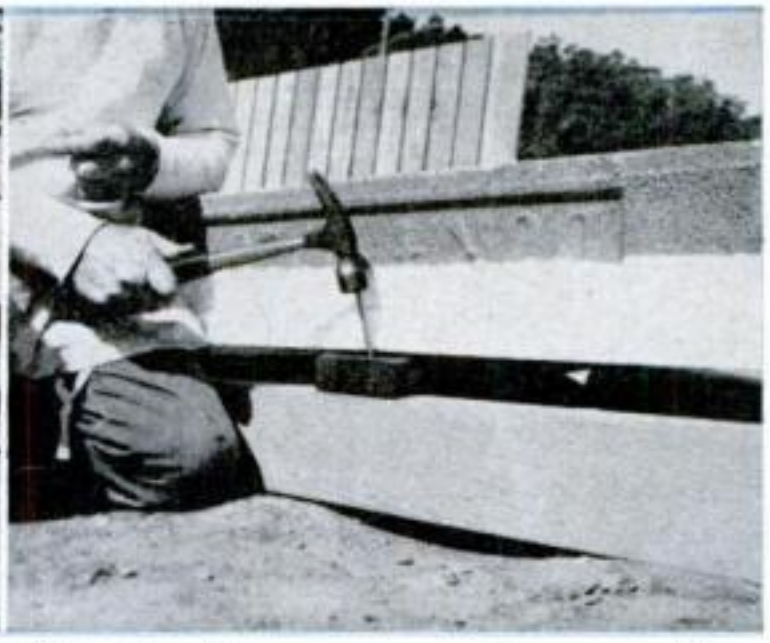
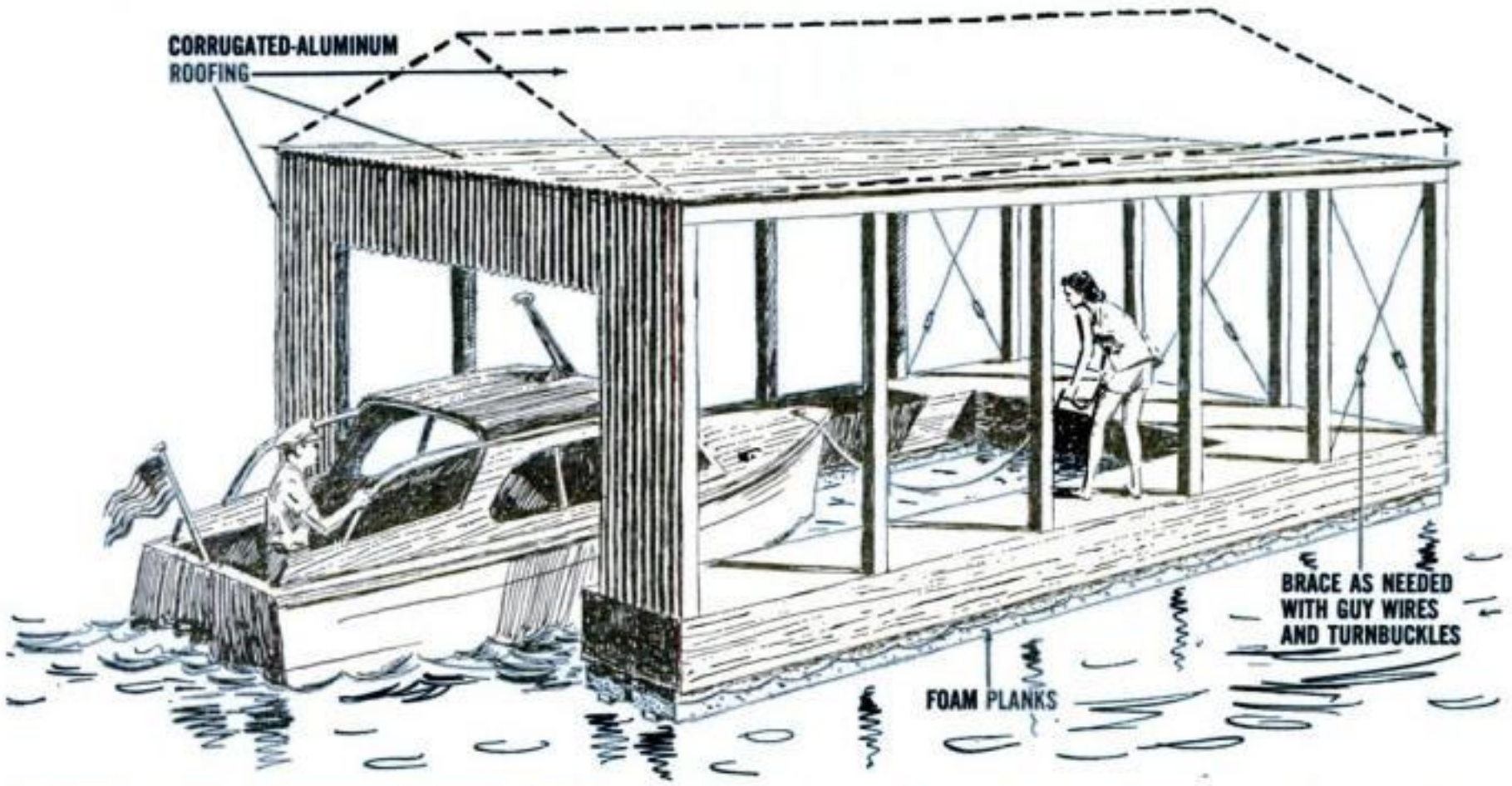


Foam planks for floats can be fastened to cross members with large pointed dowels driven in at an angle. Bore holes through cross members at opposing angles.



Place the foam cross-member assembly upside down on upper frame of the float and fasten with long nails driven through the overhanging cross member, as shown.



Lightest and cheapest floating boathouse is made with a shed roof. Sturdier peaked roof is shown in dotted lines. Studs can be on 4′ centers, but structure should be braced with cables and turnbuckles. Best material for roofing and sheathing is corrugated-aluminum roofing. Add up total weight of materials and buy foam planks to provide ample flotation.

FLOATS, BOATHOUSES

For another $125 you can add a steel frame on auger-tipped legs to support a canvas boat shelter. Or you can go really posh and have a custom-built floating boathouse —for $700 up.

If the water level is constant, all you need is a pier on piling or ready-made legs. If the water level varies, as in tidal water, you need a float linked by a hinged ramp either to a pier or directly to the shore.

You have a wide choice of pier supports. Driven wood piles are the cheapest, but take the most work. Also, they remain in place the year round and are subject to

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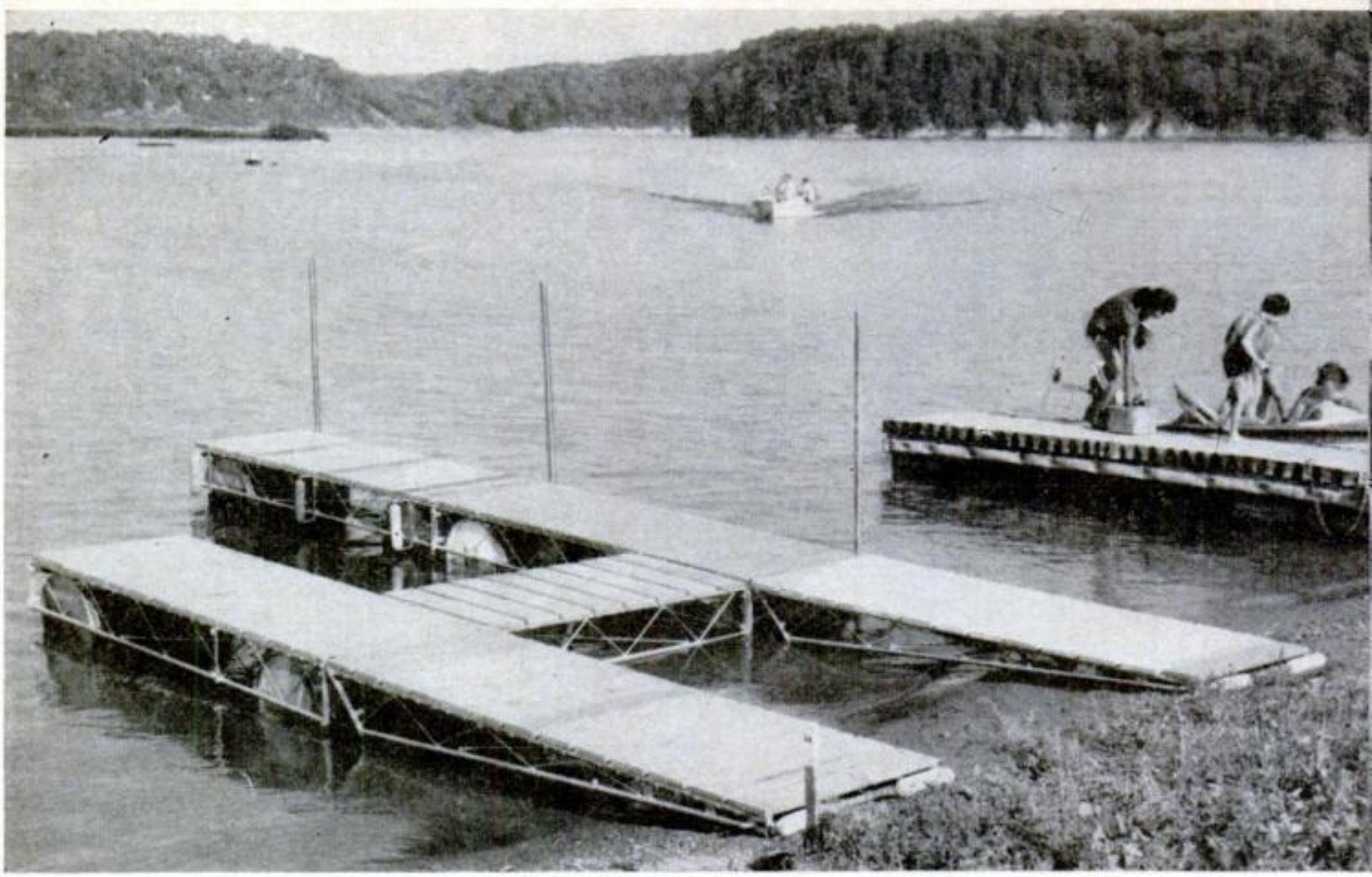
Urheberrechtlich geschütztes Material

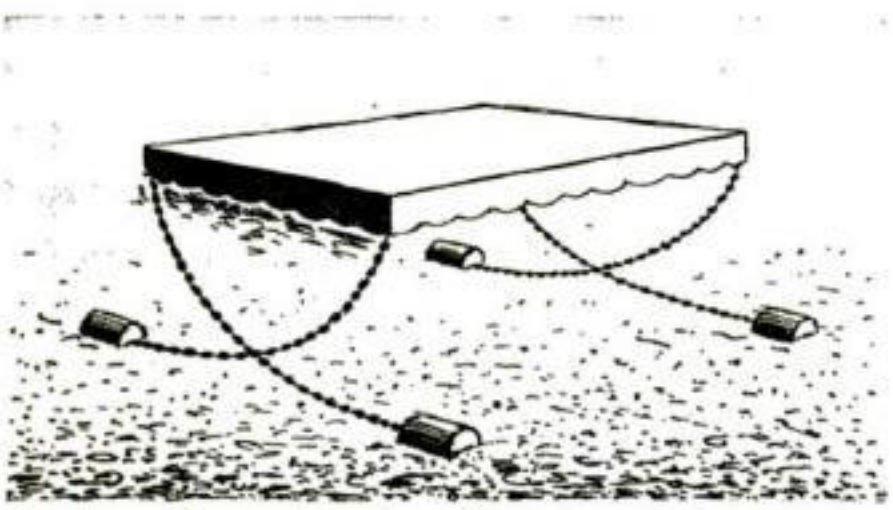


Custom-made piers like this one can be put together from modular units. You buy the individual parts ready-made and assemble a dock to suit your individual requirements.

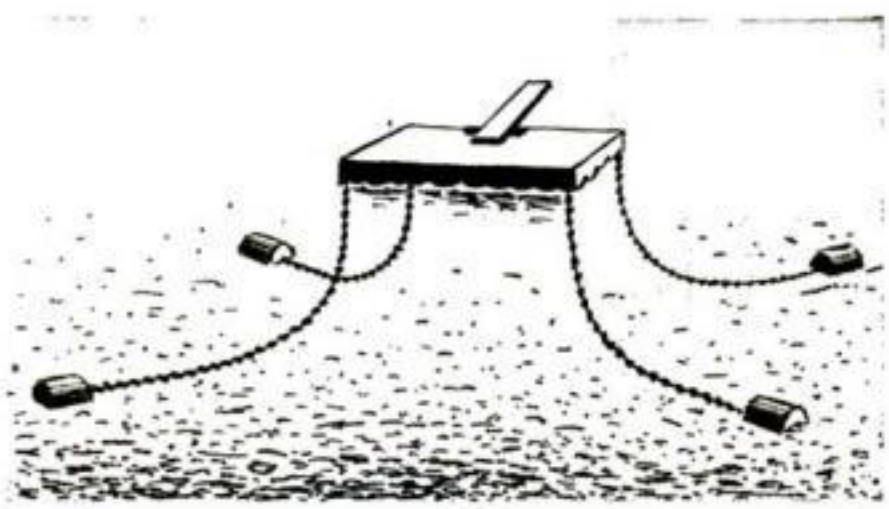
winter damage. Pipe supports flanged to wood cross members on the bottom cost more but are easier to set up—and they're removable. Handiest of all are ready-made metal legs. For average bottom conditions, they are tipped with a jumbo-size auger bit. For rocky bottoms, there are flat-base legs with a steel foot about eight inches square that simply rests on the bottom. Typical price of a pair of 4′ legs with cross member is $14.50, from Indiana Galvanizing & Mfg. Co., Muncie, Ind.

If you use driven piles, there are three common ways of driving them without special equipment. In shallow water, you can drive small piles with a sledge. Longer piles can be "wobbled" in. Swing the upper end around in a small circle while bearing down. A squared point on the base of the pile is better than a round one.

Another method calls for a husky jet of water, as from a power bilge pump. Run a hose from the pump intake to a strainer in the water. Run another hose to a length of pipe (around ⅜-inch) tied loosely to the pile with string. The outlet of the pipe



Anchors for swimming floats in shallow, constant-level water should be arranged as above. Make anchors by filling five-gallon drums with concrete and setting eyebolts in the concrete.



In deeper water or tidal areas, arrange the float-anchor system like this. Leading anchor lines out diagonally from the float helps avoid the danger of swimmers diving into them.

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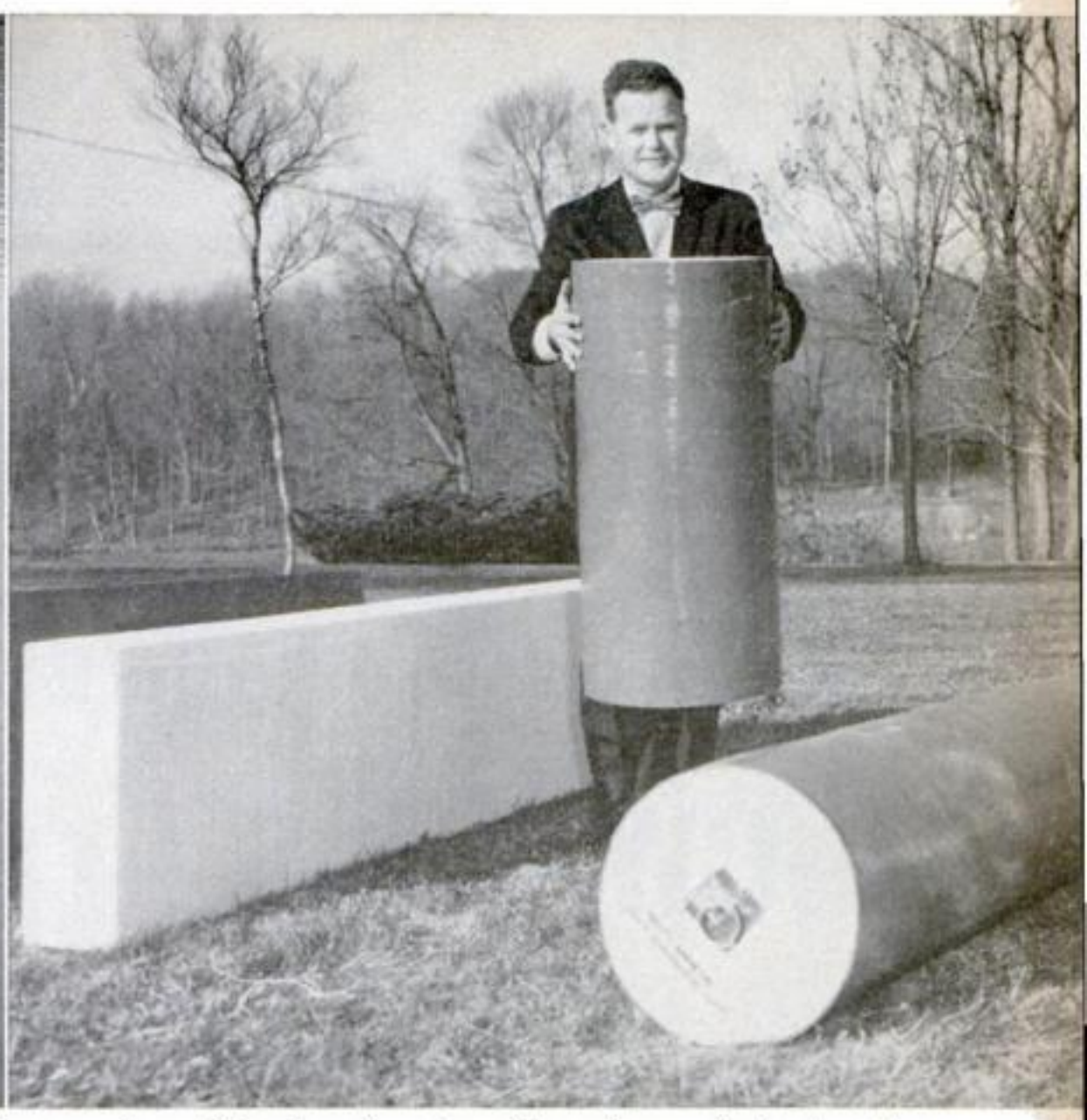


Foam flotation comes in different sizes and shapes. These foam logs have a center core of lumber for strength and easy fastening. Logs at right are encased in protective plastic skin.

should be close to the pile's point. In mud bottoms, the water jet will chew out a good-size hole ahead of the pile.

Most floats are supported either by 55-gallon oil drums or "planks" of polystyrene foam. A standard drum costs $2 to $3.50, about $5 galvanized. A plank of polystyrene foam 10″ thick, 22″ wide, and 9′ long supports about 800 pounds, costs around $24. Caution: A constant film of oil and gas on the water's surface will erode the foam's surfaces.

A wood skirt that extends around the float with tight corners keeps the film away from the foam. Where the skirt isn't practical, you can use solvent-resistant Dow Tyrilfoam.

Keep floating docks in position. The best way to keep a float where it belongs is with a pile driven close to each side. A loop of chain attached to the float runs loosely around each pile. This holds the float but lets it ride up and down with the tide.

A ramp hinged to the end of a pier moves up and down in an arc at its outer end. But the float rides straight up and down. To provide for the difference in motion, use nonswiveling casters under the float end of the ramp. (You can buy them from Bassick Co., Bridgeport, Conn.) Place float and piling to allow a margin for the movement. Where piling can't be driven because of bottom conditions, a wide ramp, hinged at both ends, will hold the float. This calls for a rugged ramp and hinge system.

Boathouses and shelters. You can build a knockdown canvas-covered boat shelter alongside your dock by driving a few piles about 2′ farther out than the boat is wide. The size of your boat and your own horse sense are your best guides for details. You can get a wide range of plans and ideas from the Outboard Boating Club of America, 307 North Michigan Avenue, Chicago 1.

A floating boathouse is essentially a pair of long, narrow floats a little more than boat width apart, supporting a lightweight shed closed at one end. They're handy in tidal areas and they're not hard to build. You can get plans for a 26-footer on styrofoam flotation from the Dow Chemical Co., Midland, Mich. Or you can order one made to order by the Blanton Plow Co., Rome, Ga. Prices start at $715. ■ ■

Urheberrechtlich geschütztes Material

A Buyer's Guide to Boats

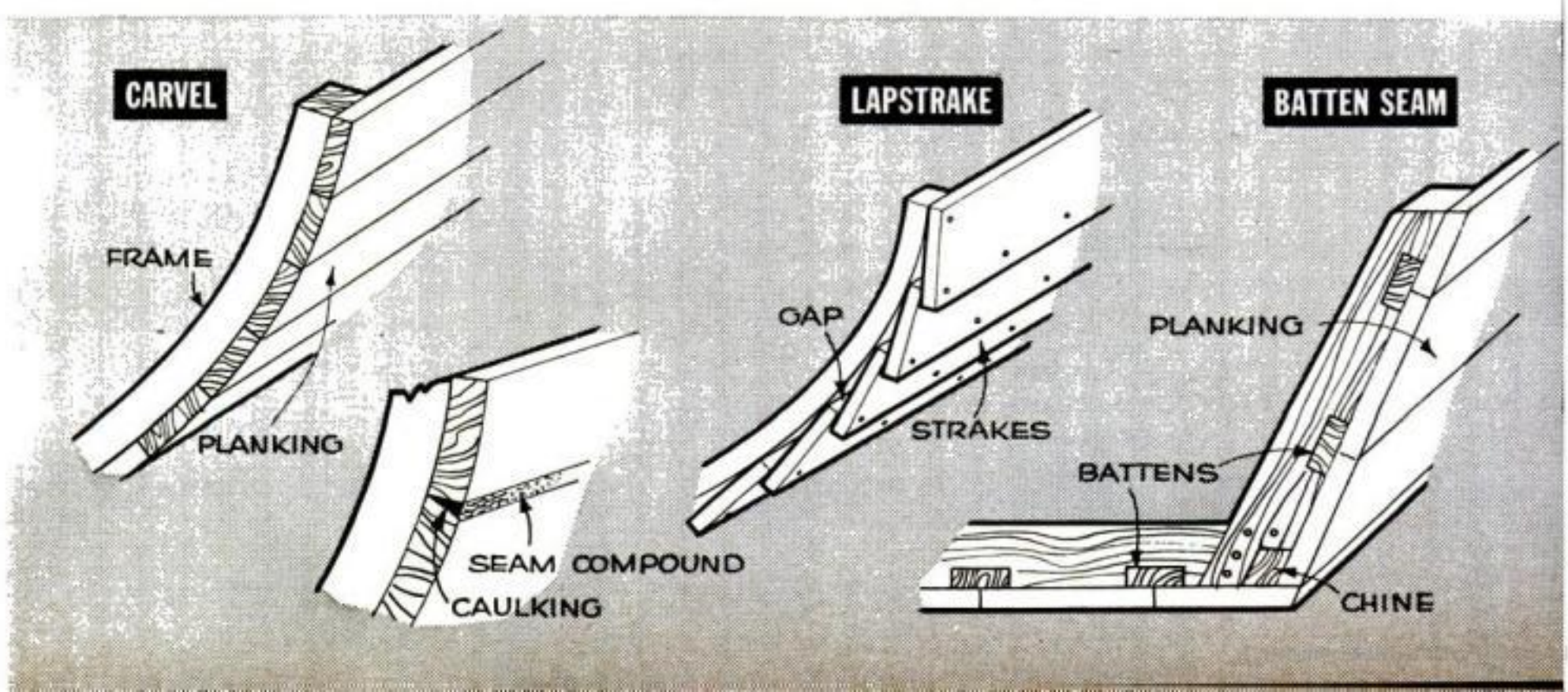
How Hulls Are Made

By George Daniels

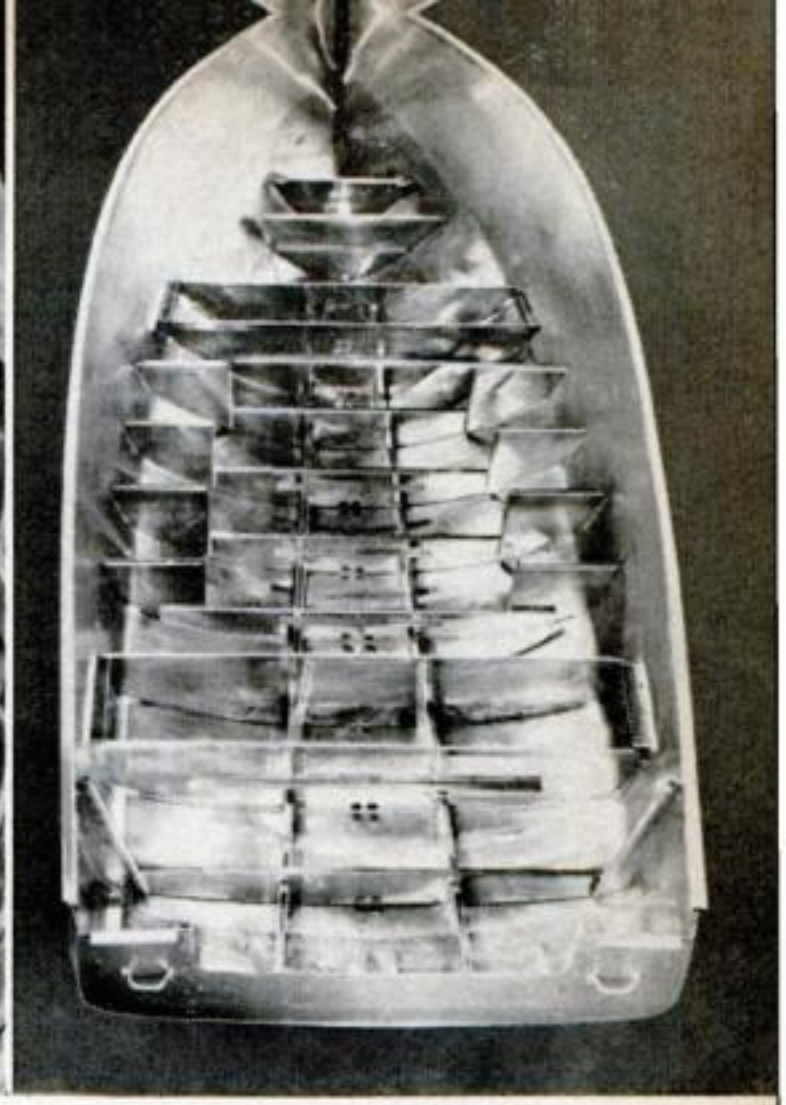
GO BOAT shopping these days and you have your pick of around half a dozen materials, more than a dozen basic types of hull construction, and an endless stream of variations. What can these combinations do for you and how do you make a choice? Let's start with the time-honored hulls.

Carvel (smooth) planking, one of the oldest forms, got its start on the ancient Nile. But it got its name from a 15th-century smooth-planked type of ship called a "caravel." (Two of Columbus' three ships were caravels.) Advantage of carvel planking to the modern boat builder or buyer: It's an easy type to apply and repair. A damaged plank can be removed and replaced without disturbing adjacent ones. Today, however, the term carvel isn't limited to wood. It's applied to smooth hulls of any material.

Lapstrake (clinker-built) hulls were well proven by the Vikings, who roamed the seas in lapstrake double-enders with strakes laced together by leather thongs. Advantage of lapstrake then and now: As strakes overlap like clapboards, their edges can be fastened together in a watertight seam. Copper rivets usually do the job today. The fastenings also resist hull twisting, so you can have a lighter hull without sacrificing seaworthiness. The strakes are now



Good lapstrake and carvel wood hulls using steam-bent frames feature close frame spacing. Fast powered types and some canoes have extra interspace frames plus added longitudinals on the bottom for added reinforcement.



Curvature of hull sides makes side frames unnecessary in this aluminum sport utility. Bulkhead-type bottom framing stiffens hull skin below waterline and provides support for seats and floor. Two rows of rivets hold seams.

usually plywood strips. But, as many skippers like lapstrake for its appearance, you'll see many molded fiberglass jobs in lapstrake form. The term still applies. In any material, the "overlap" ridges below the waterline tend to reduce rolling by acting as small bilge keels.

Batten-seam planking (sometimes called ribband carvel) has sealant-coated wood strips backing up each seam inside the hull. Held to the planking by metal fastenings, the battens create a "sheet-plank" effect like plywood. The result: a tough hull with little chance of leakage. If you're a first-time builder planning a planked hull, the battens can make up for many a seam-fitting flaw.

Double planking consists of planking layers laid at an angle over each other with sealant-impregnated fabric between. The inner layer is usually angled about 45 degrees backward from the keel. The outer layer runs fore and aft. This form got its start before the days of marine plywood and kept many an early seaplane watertight. It's still widely used, especially on larger hulls, because of its special merits. As it goes on a layer at a time, it provides a way to make heavy planking take sharp curves. And, as the outer layer is thicker than most plywood facings, it isn't likely to scuff away in accidental grounding.

Strip planking is made up of wood strips about as thick as they are wide, commonly

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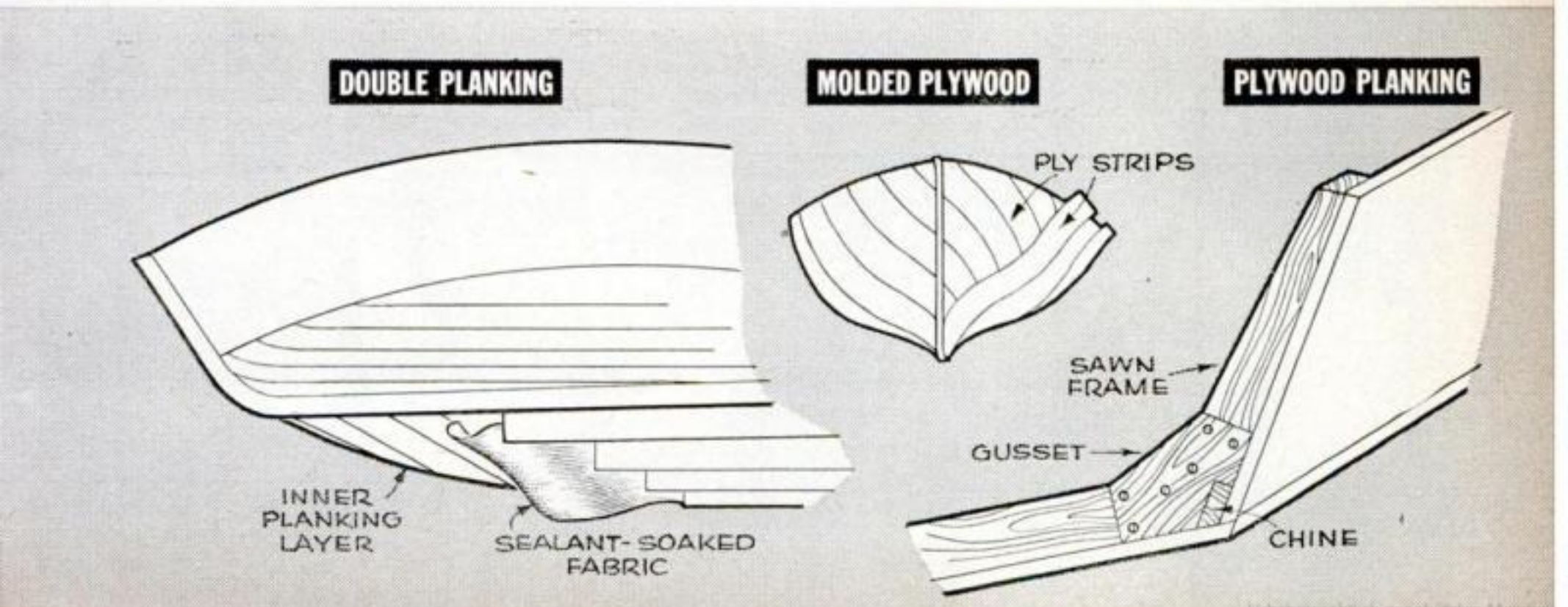

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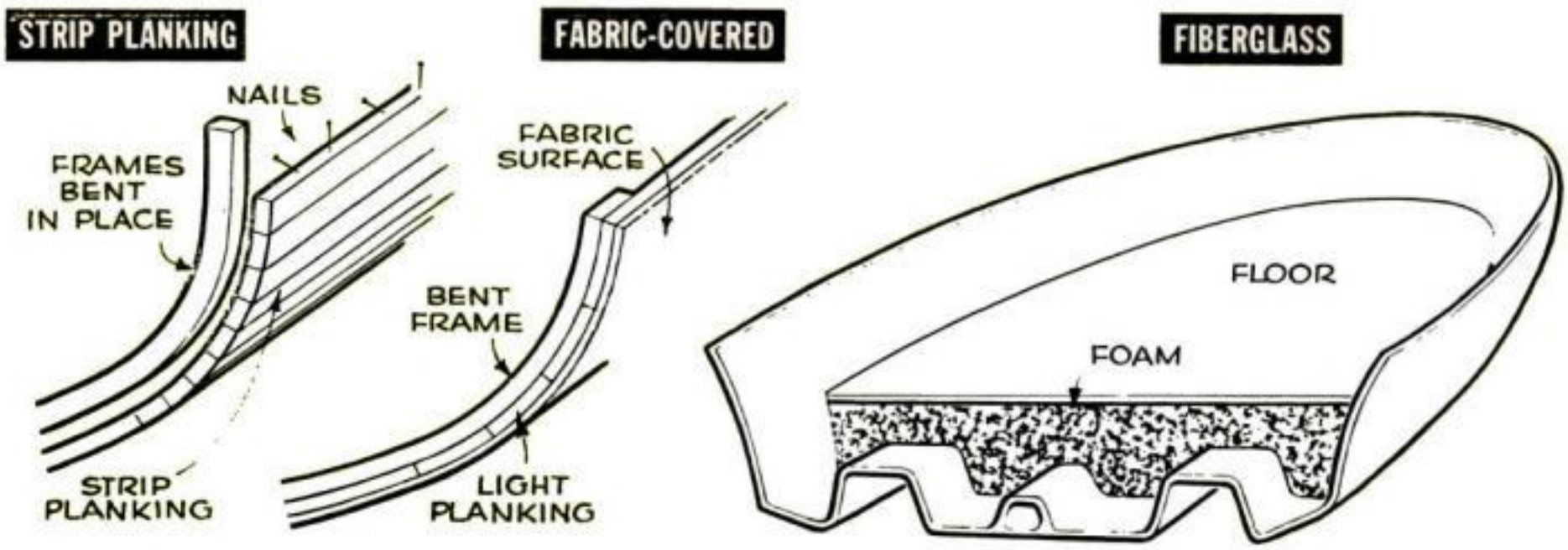


around an inch square in cross section. The strips are fastened to each other by nails driven edgewise through each successive plank into the preceding one. The entire job is done over a temporary form, with frames bent into place last—the reverse of usual procedure. At curves like the turn of the bilge, the strips are beveled to fit. Old-timers used white lead between strips. Resorcinol glue now takes its place. Although you seldom see strip planking nowadays, it's a rugged form made even tougher by modern glues. And, for the nonprofessional builder, it offers an easy way to form rounded hull contours. The strips can bend in any direction, eliminating much tricky fitting.

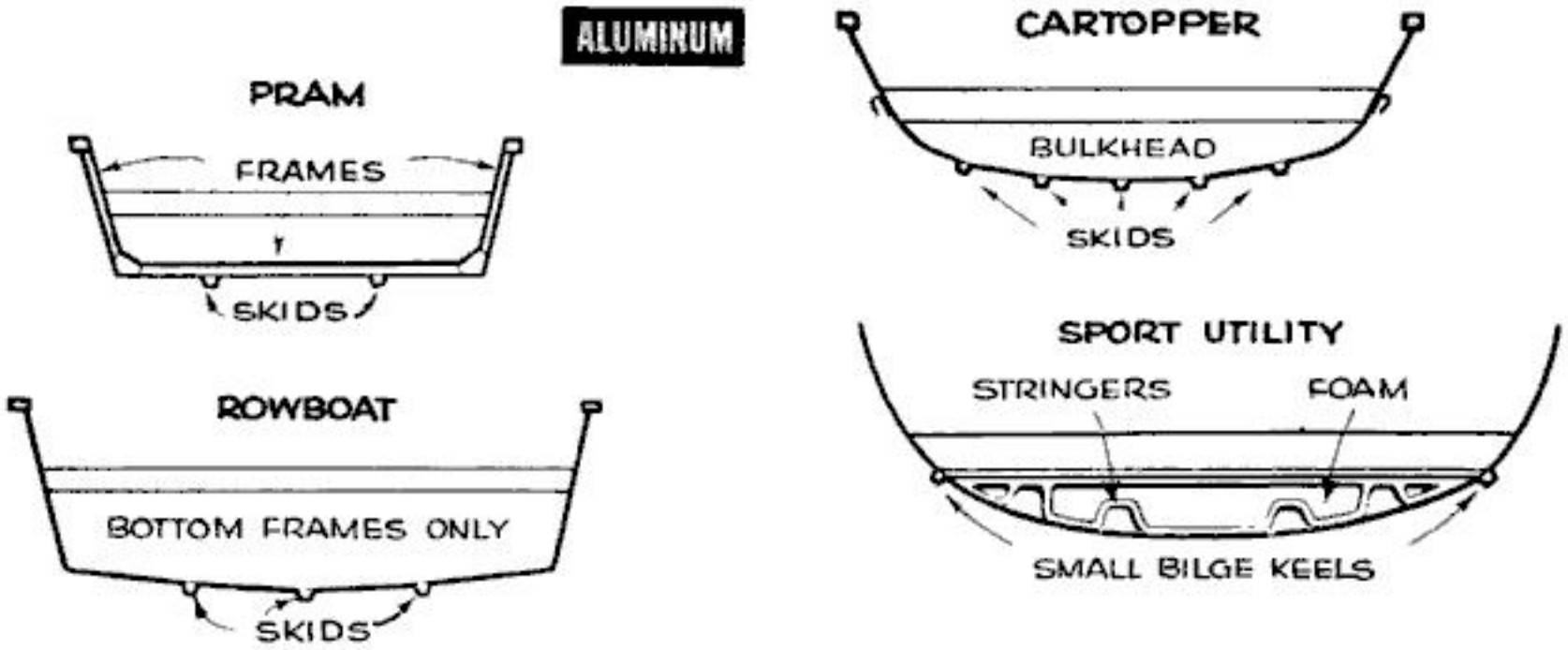
Plywood planking, stronger than steel (pound for pound), is suited to V, semi-V, flat-bottom, and similar hulls. It can take any curve within its bending radius. Because of its very high resistance to splitting, plywood planking need be only about half as thick as ordinary wood, and frames can be about a third farther apart. (You'll notice the increased spacing in most plywood hulls.) The overall result: light weight and high strength.

As it reduces the chance of leakage by reducing the number of seams, plywood planking leads as a home-built-boat material, but the difference between exterior and marine grade should be understood. Both are made with completely waterproof glue. But, as exterior grade is used for home construction and doesn't have to be bent, more surface flaws and core voids (gaps in inner plies) are allowed. This reduces cost but boosts the chance of breakage at hull bends. Top-quality marine plywood (like Royal Marine) also is limited to heartwood faces (no sapwood) for best finishing results.

Molded-plywood hulls are formed by crisscrossing veneer strips (with waterproof glue between) over a mold. An airtight cover sheet, drawn down by vacuum, provides the clamping pressure. Weight for weight, it's one of the strongest hull constructions with little or no framing, but

Lightweight planking on this hull is called "diminished" because it narrows toward stem. Here, it is being sanded in preparation for Dynel covering already applied to other side.

Fiberglass hulls are surfaced with glass fabric, provided with body by glass roving and mating. Layers are bonded with polyester resin or epoxy. Here, fabric is applied to resin coat.



limited to rounded hull forms. It's a good choice if you want the natural beauty of wood plus strength.

Fabric-covered hulls may be either wood or plywood. The fabric is usually canvas, fiberglass, or Dynel. Canvas costs least, adds watertightness, but not strength. Fiberglass costs more, weighs more, but adds strength and watertightness. Dynel does the same job but is lighter and easier to apply. Advantage of fabric covering: It makes lightweight hulls watertight, sometimes stronger, and can do the same for many old boats not originally covered.

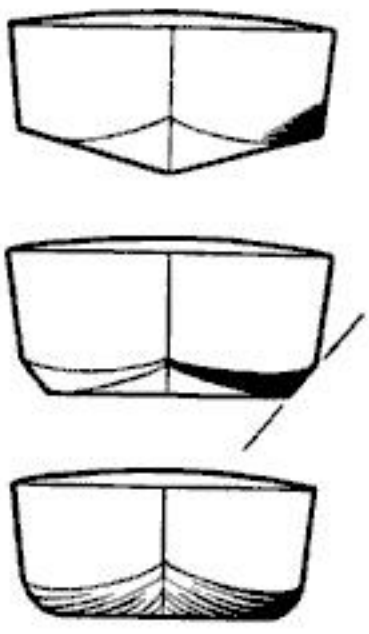
Fiberglass hulls rate with the toughest, and can be made in shapes not practical with other materials. Hull-shell thickness runs about half that of plywood. But the greater flex of fiberglass calls for stiffening by curved hull surfaces, molded-in framing, sandwiched flotation, or a combination of the three. Important if you're buying: Fiberglass is easy to repair, low on maintenance, tough, and free from borer attack. But hulls of this material are easily copied by second-rate builders. So be sure of the maker's background. Low-quality hull troubles don't show up until too late.

Aluminum hulls vary least in weight and form because the metal varies less than other boat-building materials. Skin thickness varies from .032″ in a typical canoe to around .091″ in runabouts and small cruisers. (Use a feeler gauge to get an idea of the thicknesses.) As these weights are too thin for easy welding, rivets do the trick. In a quality hull they are likely to run along seams in twin rows at ½″ spacing. A permanent elastic sealant is sandwiched in the seams.

Dent repairs are easy in auto-body fashion. Loose rivets are tightened by tapping with one hammer, bucking the other rivet end with another hammer. But if you use antifouling paint, be sure it suits aluminum. Some, though good on wood, can cause aluminum damage. How durable are they? Manufacturers like Duratech give a 15-year guarantee against skin puncture or popped rivets.

Steel hulls, though not commonplace, range from Pioneer's 12-foot utility to Inland Steel's luxury yachts. If you're buying an unfamiliar make, check on the hull's protective coating. Multicoating with modern resins assures long life.

Rubber-covered-framework boats like kayaks and larger folding types are handy if you're an apartment dweller with no trailer space. Quality models are covered with five-ply rubber or neoprene and can be patched as easily as a tire tube. Folded, they fit in back seat or car trunk, and can be assembled in 15 to 20 minutes. How tough are they? One model traveled 22,000 miles in a five-year voyage from Germany to Australia. ■ ■



About chines

Top hull has hard chine. This is easy to build in plywood, lessens tendency to roll, but may dig in on turns in choppy water. Center is beveled non-trip type, won't dig in, can be plywood or other sheet material. Bottom is familiar rounded soft-chine, sea-kindly type that won't dig in even on choppy turns.

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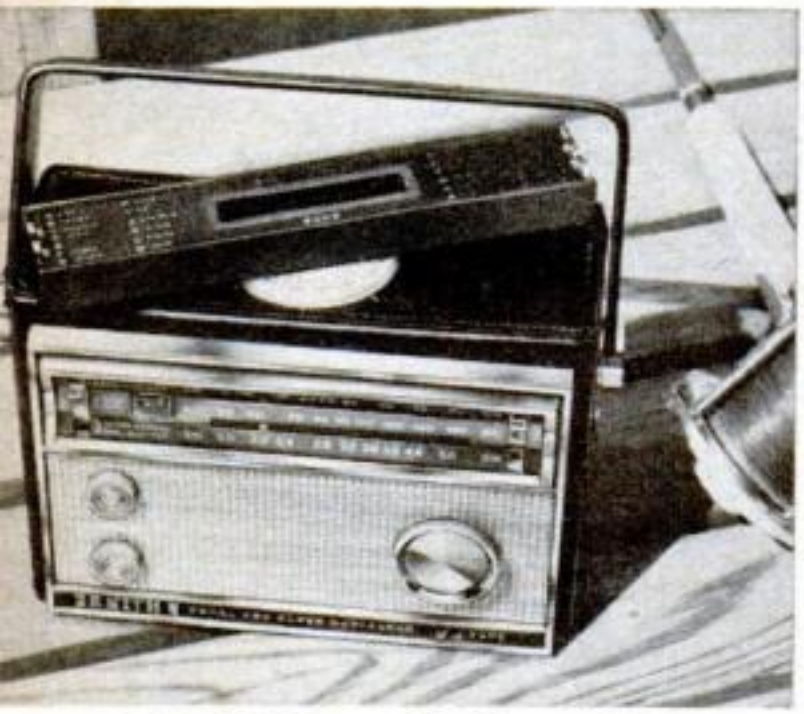
1. Evinrude Sport 16



2. Zenith Super Navigator RDF

3. Heath rudder indicator

what's new

Planning to buy a boat this year? Or more equipment to make the boat you have more fun? Then you'll probably be heading for the nearest boat show come spring. Boating Editor Jim Roe has been busily previewing what you'll see. Here's a sampling:

THE Evinrude Gull Wing Sport 16 (1) will be afloat in two models for 1965. Both 16-footers are rafted together in the photo. The stern-drive model at top has the two rear seats removed and the front cockpit cover snapped in place. The outboard version has all four seats in place and the front cockpit uncovered to show the molded-in seats. The regular seats in these boats are easily removed from their floor fastenings to clear the deck area for fishing, or handling skis or skin-diving equipment. They can also be taken ashore to serve as handy chairs for picnicking.

Bowing in, too, is a smaller 14′ and stylishly dressed Evinrude called the Playmate. Equipped with a 90-hp. stern drive, she is a lively lady indeed.

● Zenith's brand-new Super Navigator radio (2) is a highly sensitive and selective all-transistor portable that

Urheberrechtlich geschütztes Material

PS BOATING welcome aboard!

By Jim Roe
PS BOATING EDITO

4. Aluma Craft Fisherman R-7

in BOATING for 1965

tunes in on three bands: 540-1,600 kc. standard broadcast band, 150-400 kc. aviation weather-navigation LW band, 2-5.0 MC marine short-wave band. It can also be used as a self-powered standby navigational instrument for homing and cross-bearing reference on boats. Though it weighs only 5½ pounds with batteries, the Super Navigator has a rotating antenna housing with three ferrite plate-type antennas, one for each band. The DF switch and level control permit manual adjustment of sensitivity for sharper null indications even on strong signals.

● A rudder-position indicator (3) is the Heath Company's newest kit. It will continuously show rudder position up to 40 degrees both port and starboard, greatly simplifying maneuvering at the dock, and can be used on single- or dual-engine boats. The sending circuit is voltage regulated, and the unit operates on either 6- or 12-volt batteries.

● One of the handiest fishing boats we've seen in a long time is Aluma Craft's R-7 (4) for 1965. It has a rounded gunwale, a cast transom knee, wide seats, and carrying handles. This is a 12′ 2″ boat with a 55″ beam. Transom height is 15″ and it's rated for a 20-hp. motor. The R-7 weighs only 145 pounds, making it

CONTINUED

5. Lone Star's 14′ Tracer

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what's new in BOATING

6. Century's 50-m.p.h. Bronco

7. Square bumper! By PAR

8. Starcraft Newport

easy to haul and to handle at the best fishing grounds. It's fitted with foam flotation and has an OBC load capacity of 646 pounds. Standard equipment includes oarlock sockets, a drain plug, and a bow eye. If you wish, you can get it with a forward deck, a side-steering deck, windshield and up-front steering, aluminum oars, and an anchor cradle.

● A really fine runabout and ski boat (5) is the new Lone Star Tracer—a 14-footer, built of fiberglass molded into a lapstrake-style hull for a soft ride and easy handling. A fast and perky boat, the Tracer is also rugged, seaworthy, and buoyant. She gets her buoyancy from Foam-Pac flotation. Polyurethane foamed into the Tracer between the outer and inner hulls hardens to form a strong layer of flotation that is impervious to spilled gas and oil.

● The speedster galloping along at full tilt in the top photo (6) is Century's brand-new Bronco. With its standard engine (a 165-hp. V-8 Interceptor with Eaton outdrive), she goes close to 50 m.p.h. Optional extra power is available to lift the speed limit to 65 m.p.h. The Bronco is a 17′ sports runabout with new exciting touches everywhere you look. Bucket seats are fiberglass shells upholstered with black leather-grained vinyl. Each seat is equipped with a headrest. The instrument console at the driver's right hand is black vinyl, too, with aircraft-style instruments individually lighted.

● Ever see a *square* bumper? Look at photo 7 and you will. It's Peters and Russell's, and they call it the Buffer. Not only are Buffers different in shape—they are pneumatic and can be pumped up to the appropriate pressure. The one shown, 6″ square and 26″ long, costs $16.95. Its makers say it protects a larger area on the side of the hull, and extends above the rub railing to give extra protection against topside damage should the boat slip beneath the dock. Another advantage claimed for the square bumpers: They stay put more readily on a hull and are less likely to roll away from their job when protection is needed. Buffers come in three sizes.

● Starcraft's new Newport runabout (8) looks as capable in the air as she really is in the water. She's built of fiberglass, with a lapstrake hull design above the sheer. Below, she's a deep-V from bow to stern, with molded-in longitudinal strakes. These give lift for planing at high speeds, and cushion the re-entry into rough waters. A rugged, capable boat, she's a fast and agile performer with the 100-hp. Mercury outboard that's clamped to the transom in this photo.

● One of MFG's new water babies is this 14′ Challenger Custom (9) of fiberglass. It's designed as a fishing and utility boat, as well as a fast ski boat and runabout. The Challenger Custom has one of the multi-keel bottoms [see PS, Dec.]—a trihedral, or three-keel hull construction.

● One of the star performers in the Owens 1965 cast is the Princess (10), a 24′ inboard/outboard

Urheberrechtlich geschütztes Material

cruiser. This take-the-whole-family boat is built of five-ply Duraply and powered with a 150-hp. MerCruiser with power tilt. She'll sleep four, and comes with a galley and enclosed head. Equipped with Ride Guide steering and single-lever throttle and clutch control—and all other instruments you need to put her right in the water and get going—the Princess sells at a remarkably modest $5,645.

● The triple-nosed Johnson boat (11) scoots along at the urging of Johnson's new V-90 outboard motor, the Golden Meteor. This matched team gives not only a smooth, but a very fast, ride. Another of the multi-keel boats now becoming so popular, the Johnson hull rides on three dart-shaped surfaces. Sponsons on each side of the hull provide the lift, with the water they displace feeding into tunnels between sponsons and center hull.

Take your choice of two versions of the boat—an outboard runabout and a sport boat with open forward area, either model available as an outboard or with stern drive.

● If you want to be able to talk to anybody at the end of a phone in fine weather, as well as to the Coast Guard in foul weather, take a close look at the new Bendix Model 73 radio-telephone (12). A low-priced, 73-watt, 6-channel, transistorized unit, it's a worthwhile investment ($350) for even a modest-size boat. This set will keep you in touch with other boats, let you talk directly to marine-telephone operators and, through them, to your home or any other land-based telephone.

● Glastron's Futura comes in the two models shown below. The all-new Futura Sedan V-152 (13) brings sports-car styling, comfort, and performance to the 15′ class. It boasts four bucket seats with an upholstered console between the rear ones. There's lots of storage room, rugged vinyl carpeting, and a tiltable front-opening windshield. The hull is fiberglass with Glastron's Aqua Lift design.

It has a twin, too. The same hull, altered slightly at the stern (14), makes a fast-stepping stern-drive boat, the Futura 500 V-164. Engines for it range from 90 to 120 hp. This version comes with all controls, opening windshield, steering, running lights, and a built-in 12-gallon fuel tank. Color? A sparkling metallic red and white to put stars in your eyes. ■ ■

what's new in BOATING

9. Challenger Custom by MFG

10. Family-size Owens Princess

11. Johnson's 3-Nosed Speedster

12. Bendix small-boat radiophone

13. Glastron's Futura as outboard . . .

14. . . . and as flashy stern drive

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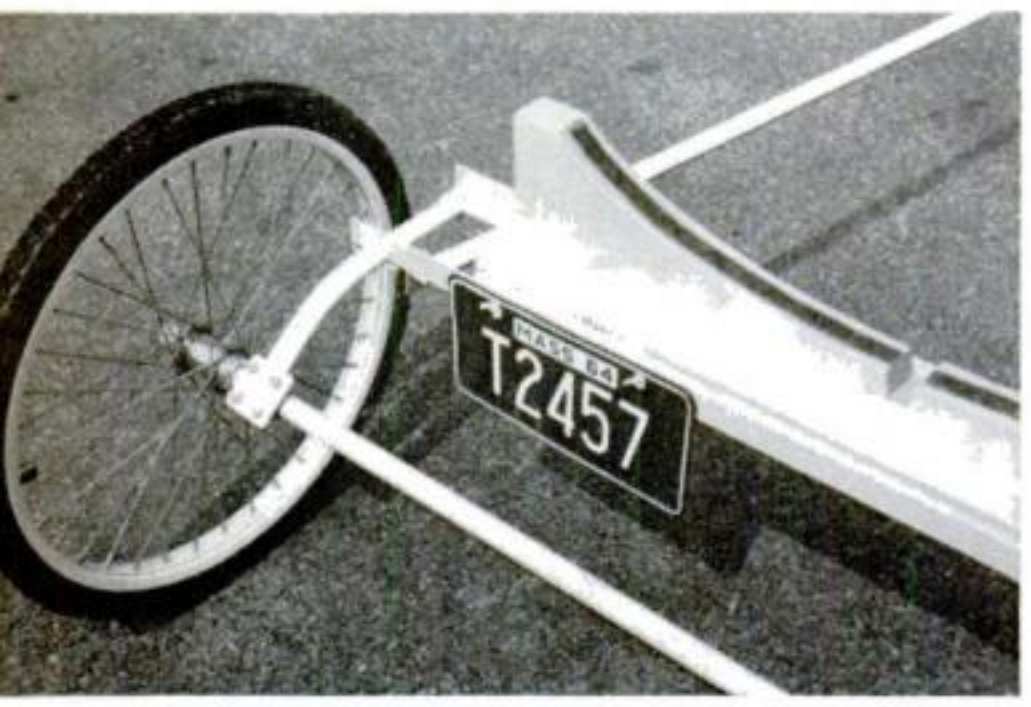
A neat "sulky," this two-wheeler firmly cuddles a canoe or any small boat for smooth trailering.

Rough roads are no problem for the flyweight boat trailer—and it plows through sand with no swing or sway, even when cornering.



Trailer rides easily on standard 24-by-1.75 bicycle tires. The wheels, however, have heavy-duty spokes, and hubs bored to take ⅝" axles.

Build This

Here's a simple-to-make rig to ease the task of hauling a small boat down to the water

By Bob Whittier

WANT a trailer for small craft that won't cost you an arm and a leg? You can build one for about $25. Heavy-duty bike wheels—the kind you see on ice-cream vendors' tricycles and horse-racing sulkies—are the key to its economy. They cost about $15 a pair with tires and tubes. A bicycle shop can order them for you.

The springs are main leaves from a Piper Cub J-3 tail skid. You can pick them up secondhand without too much trouble at small airports or order them from Piper Aircraft, Lock Haven, Pa.

Make up the axle first. It is a 48" length of steel pipe 1" (o.d.) by ⅝" (i.d.). Fit the ends of the pipe with two steel cap screws 10" long and ⅝" in diameter. Drive

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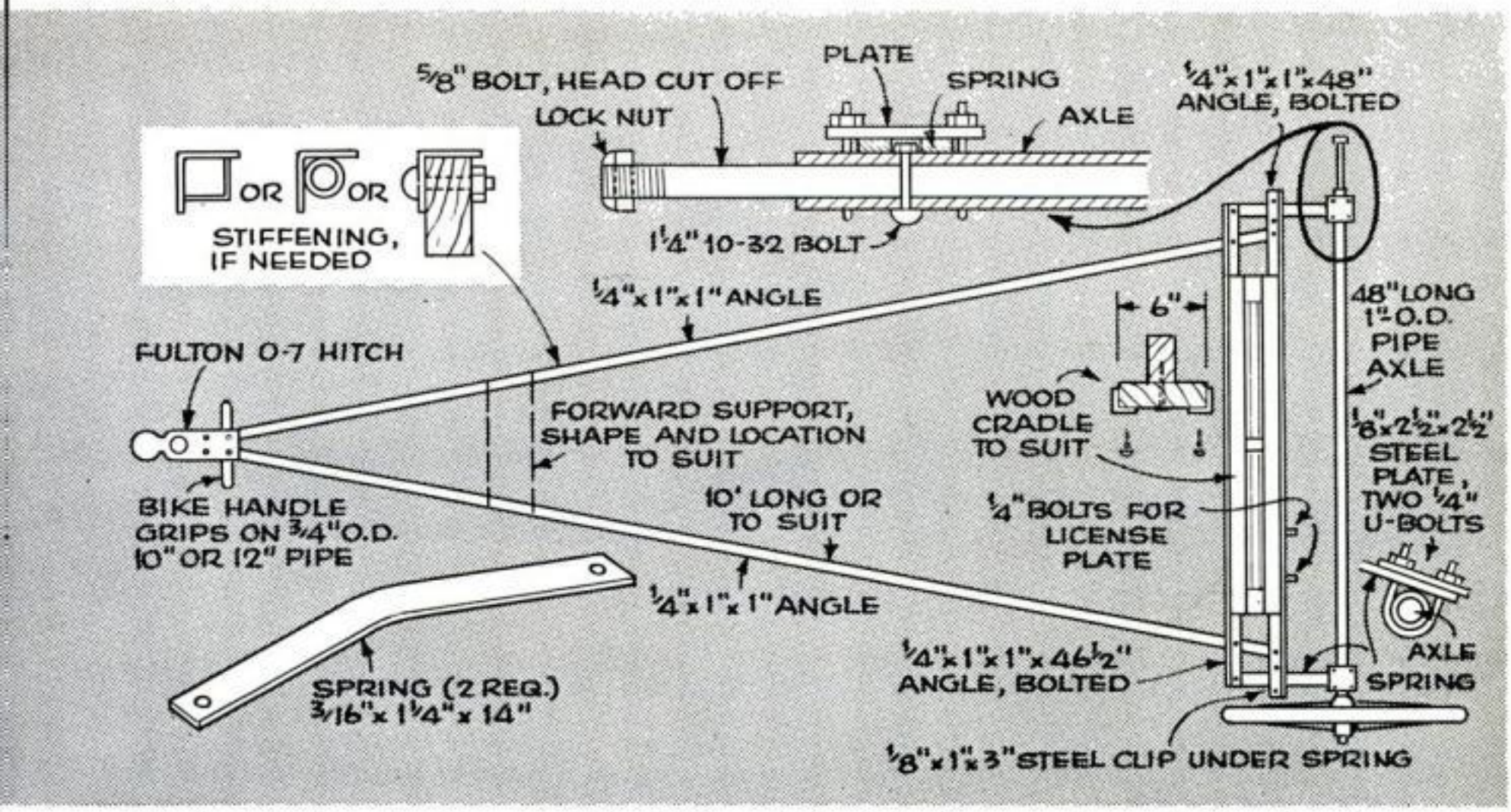

Go-ahead instructions for assembly of the small-boat hauler are shown in the drawings above.

Flyweight Boat Trailer

each one in until the section remaining exposed is equal to the hub bore length plus the hub retaining-nut's length. The wheels are held on with self-locking nuts. A few inches in from the pipe ends, drill through pipe and axle bolts and install 10-32 1¼" steel bolts with castle or self-locking nuts.

The frame. Use angle iron at least 1" wide across the flats. (My trailer's side rails are 10′ long; you can vary dimensions to suit your needs.) Set the angle iron in a V layout on sawhorses, and at the forward end temporarily attach a Fulton 0-7 trailer hitch with C clamps. Put the rear cross members in place in the same way. Adjust them so there's about a 6" space between the vertical legs to form a channel for the wooden hull support. When satisfied with dimensions and balance, take off the C clamps one at a time and drill for ¼" hard-steel bolts. Install each bolt in turn, using lock washers or self-locking nuts.

The tail-skid springs. Holes at each end of these take $\frac{5}{16}$" bolts. Bolt the forward ends to the forward cross members. The springs are held to the rear cross members with about 1"-by-3"-by-⅛" steel clips, plus two bolts. Drill the holes for these bolts so the shanks will just touch—and thereby locate—the sides of the springs.

Make up two 2½"-by-2½" steel plates and drill four holes in them for common ¼" U-bolts. Attach each plate to the rear end of one spring. The hole in the end of the tail spring fits over the head of the ¼" bolt that holds each stub axle in the pipe. Use lock washers or jam nuts—there's lots of vibration here.

The rear hull support. This is two lengths of pine. The bottom piece fits down between the front and rear cross members. Bandsaw the upper member to fit the hull, and glue and screw it to the lower member. Pad with sponge-rubber stripping or felt. The forward support, made and located to fit, is attached with carriage bolts. Be sure that it is the same height as the one used at the rear.

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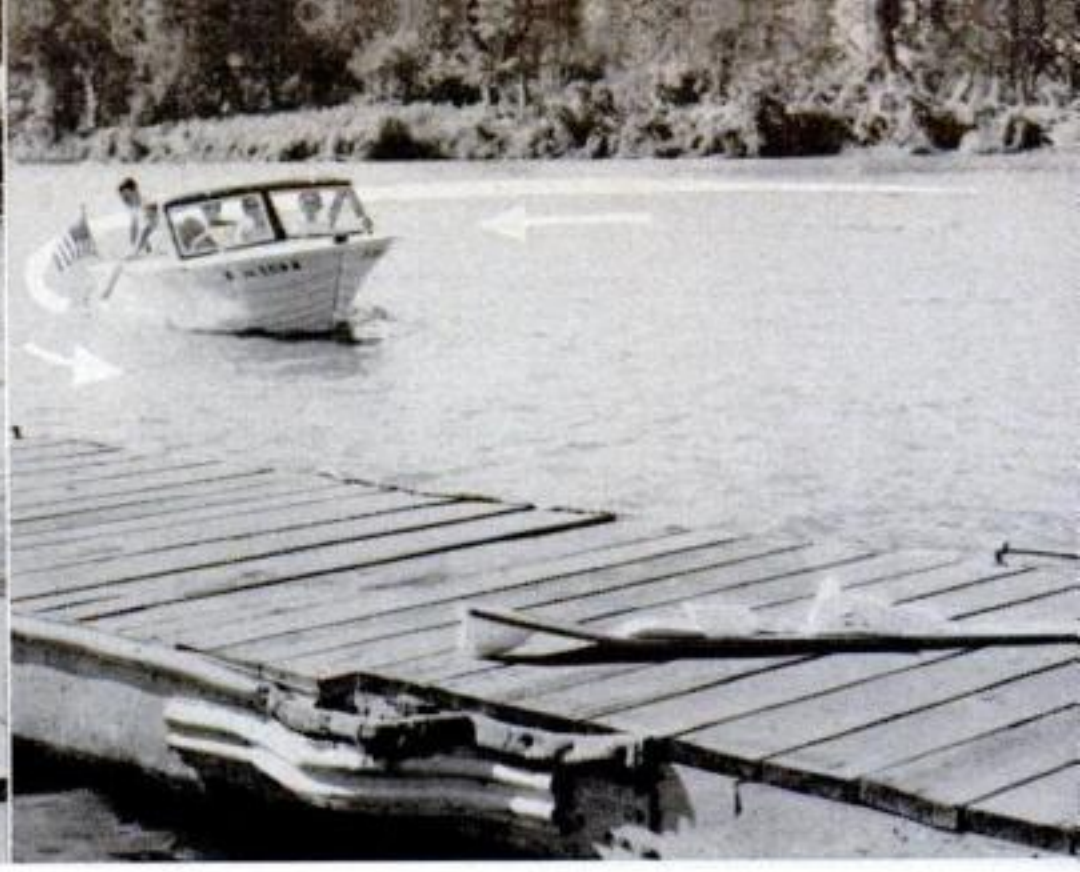

How to dock smoothly with a current running

Situation: Dock is parallel to current. Always dock *into* the current. If you approach from downstream, start your turn at moderate speed when you're opposite your intended landing spot. Bring your boat to a heading about parallel with the dock. Decrease speed as you approach the dock. When you're even with your intended landing position, your motor should be running just fast enough to oppose the current, and you should be three or four feet away from the dock. Then, by gently turning the bow toward the dock, still with just enough power to oppose the current, you can come over and "kiss the dock." Keep the motor running while a helper secures the bow line. Secure the bow line first so the bow won't swing out away from the dock.

Here are the tricks experts use

How to DOCK and

Learning to drive is easy. Here's how to glide up to the dock with never a boggle or bump

By Wayne Swegle

ANTICIPATION is the key to good docking and undocking. Anticipate what the wind or current will do to you. Tell your passengers what you're going to do and what you expect them to do—so you can anticipate their movements. Analyze what's going on and what you should do to maintain control of the situation. Then you won't be constantly surprised, reacting uncertainly to "unknown" forces.

Here are some musts for good docking and undocking:

1. "Easy as she goes" is good advice. At slow speeds, the forces acting on your boat

How to depart gracefully from

For best control, depart upstream, or into the wind if possible. Here a boat is departing upstream. The driver casts off so the bow swings out a little farther than the stern. Note that the fenders are still in place. The motor should be straight, or even turned slightly toward the

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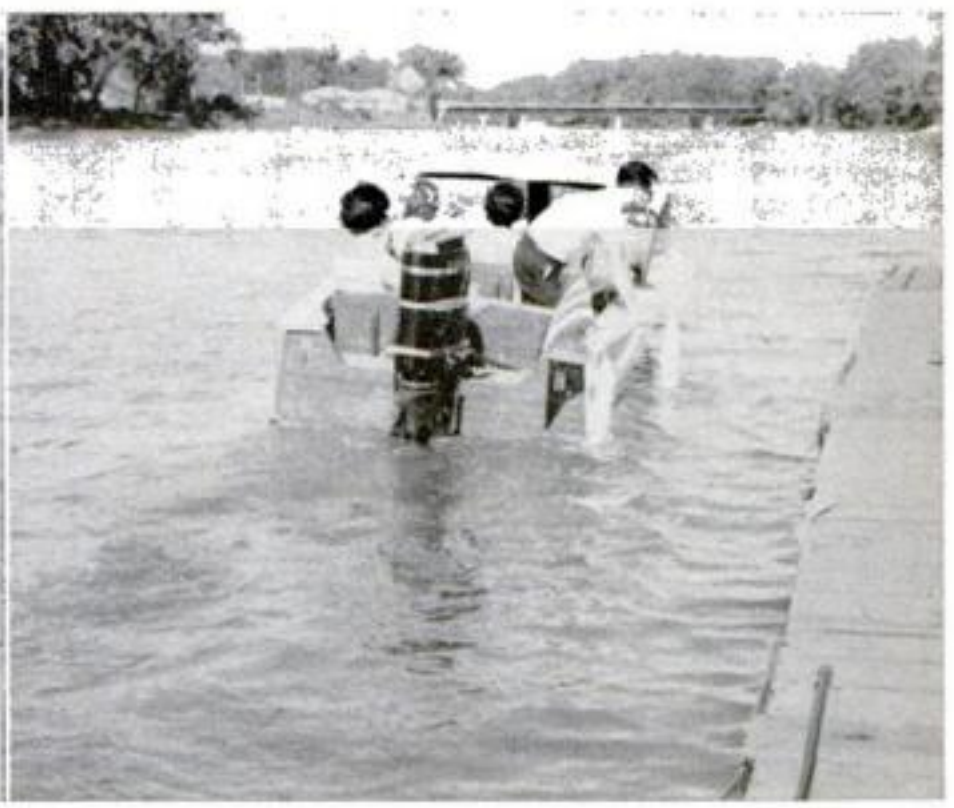
DEPART with DIGNITY



a dock, with nary a bump or a scratch

dock. Add power gradually, moving straight ahead. If you turn out as though you were driving a car pulling away from the curb, the motor will kick the stern into the dock and give you a sloppy, bumpy takeoff. At slow speed, your boat won't be hurt even if a small wave or gust of wind does nudge you back against the dock. Once you're well clear of the dock, have a helper take in the fenders. Avoid trouble —be sure that he is seated again before you add power, or you may throw him off balance, and off his feet and into the drink.

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Approaching with the current? Here's how to pull in

When you have no choice but to approach a dock *with* the current, as sometimes happens, here's what to do: Make your approach parallel with and close to the dock. Turn your bow out just a bit, and shift to reverse. Add power to oppose the current and pull the stern into the dock with the motor. Secure the stern line first. Current will hold the bow against the dock.

Approaching and departing in

Situation: crowded. Here's what you do, when at a dock like the one above or when entering a limited space between two moored boats: Approach at a steep angle. Have fenders out and a helper on the bow ready to step off with a line. When the man has stepped to the dock,

are more observable, and you are less apt to overcontrol in taking corrective action. Besides, if you come in fast you may find yourself wallowing in your own wake as you try to maneuver in close quarters. The single biggest mistake made by inexperienced boaters is too much speed.

2. Anticipate chores. Let your passengers help. Tell one to put out fenders well before you approach the pier. Get lines attached to cleats—usually one to the bow cleat, one to the port or starboard stern cleat. Give instructions to the persons who will step ashore with these lines, and get them in position. Ask other occupants to remain seated. When weight is shifted in the boat, its center of gravity shifts, and the boat will turn in that direction.

Try to keep weight well balanced. The keel will stay straight, and reaction to turns

How to approach and enter a slip—then depart with equal grace

Put fenders out to protect the sides of your boat. Approach slowly, maintaining steerageway. The boat will come into the slip easily. Note that the driver is well out in open water. Start your turn early and approach in an easy arc. Common error is overshooting the slip.

Get lined up with the slip while you're well away from it so you aren't still turning when entering. Here the boat is completing its slow, easy turn while it's still far enough away to make corrections—and the driver can approach straight on, in full control of the situation.

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cramped docking quarters takes handling finesse

reverse the motor to stop forward motion. Once the helper has taken a turn around the cleat to hold the bow in place, reverse motor and turn hard toward the dock, using reverse thrust to pull the stern over to the dock. This way you can park in a space just a few feet more than the boat's length. To depart from such a cramped space (above), do everything in reverse. Helper in the back seat pushes you off. With the motor turned away from the dock and in reverse, you add power; and your motor then pulls the stern away.

in either direction will then be more even.

3. Understand how your boat turns. It's far different from your car, whose front end turns first, with the back end dutifully following. In a boat your stern changes direction first and pushes the bow in the new direction. This is important to remember in close quarters. Many outboarders scrape the pier in departing because they turn the motor toward the pier and accelerate.

4. Note that if you're in both a current and a wind, the current ordinarily will have the greater effect on your boat. That's because a current bodily carries your boat in the direction of flow; wind simply pushes against a boat. Point to remember: Wind will affect the bow more than the stern.

Each docking situation calls for a specific technique. Several of the most common are illustrated on these pages. ■ ■

Your passengers can help fend you off if your entry isn't perfect. A little reverse thrust of the prop at this position will stop your forward motion and avoid banging the bow. If you're a little too far one way or the other, turning the motor when you give this reverse thrust can help straighten you up and make your approach look better. You're in. Now tie her up!

Departing from a slip, check all around for traffic. Anticipate what the wind will do to you when you leave the protection of the dock. If necessary, turn your motor to back you slightly into the wind, so you'll come out in the clear. Back far enough to get straightened out before shifting to forward gear. Always remember to keep the speed down—that's all-important.

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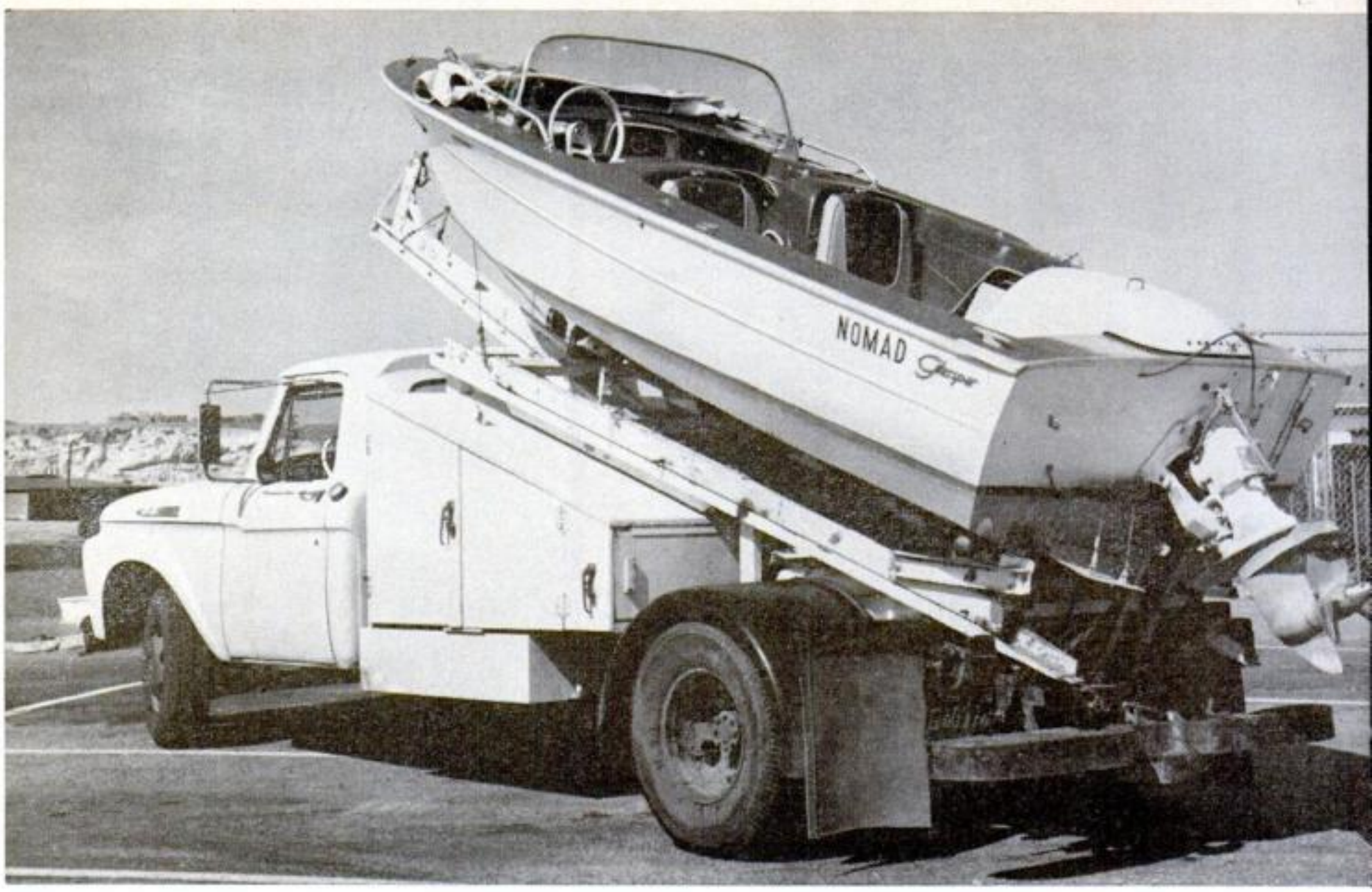


When You Go Down to

The secret of exciting boating: taking your boat to

ALL over the United States, new, different, and interesting waterways are just a short drive away from you. And no boatman is ever satisfied to sample only one of them. This means that a boat has to be as easy to handle on the highway as on the water. Here are several ways to get your boat from here to there.

Boat carrier and camping trailer combination bears the name of Skipper's Inn. Folded up for use as a trailer (below), it's only eight inches deep, and can handle a boat up to 16 feet and 1,200 pounds. A tilting chassis or a winch help with loading and launching.

PS BOATING welcome aboard!

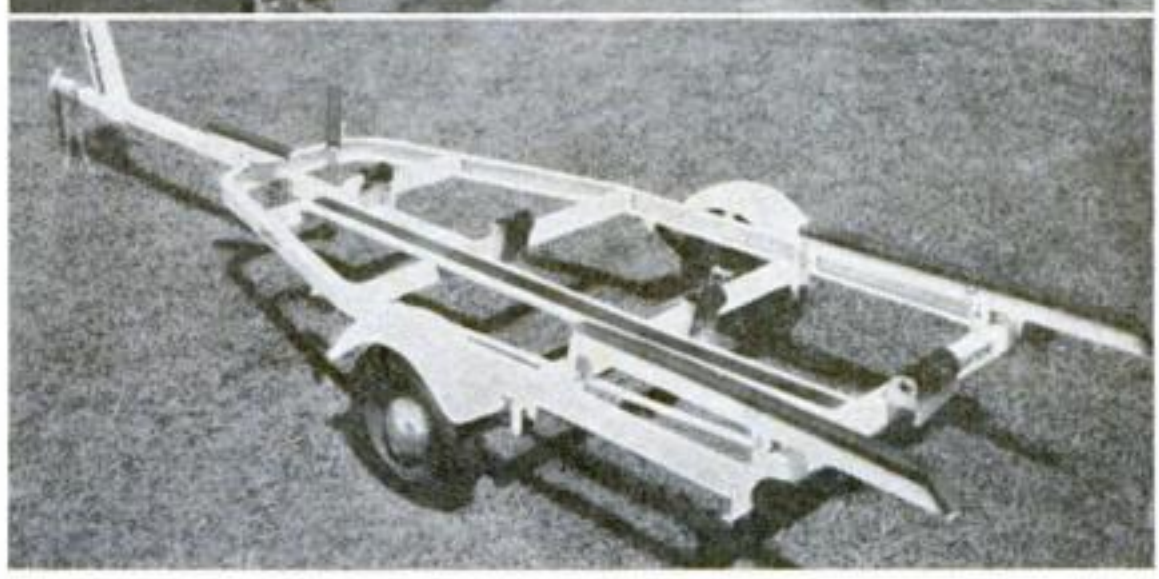
Pull a house trailer and take a boat along, too? Phil Jones of California does it with the specially fitted truck at left. The boat rides on a rack over storage cabinets. To launch, extension rails similar to those used by auto-carrying trucks allow the boat to glide into the water. A regular boat-trailer power winch does the work.

the Sea with Your Ship

new waters. Here are handy ways of cruising there by land

Power winch that loads and launches boats weighing up to 4,000 pounds has an enclosed, self-lubricated motor that runs on your car battery. The unit weighs 20 pounds, mounts on any type trailer. The motor, sealed in a corrosion-resistant aluminum housing, has a self-torque clutch, diagonal brake, reduction gears. Lectro-Loader comes complete with all wiring, circuit breaker, and connectors to make a permanent plug-in hookup to your car.

Complete package designed for medium-size boats, this 1,300-pound-capacity trailer by Gator comes equipped with directional lights and auto connector. An adjustable stand can be fitted with either a hand or power winch. The new trailer has a nonskid steel walk board, tilt lock, limit chain, and double safety chains that attach to a car's trailer hitch. Five-inch rollers support the keel; a rear roller eases on-off jobs.



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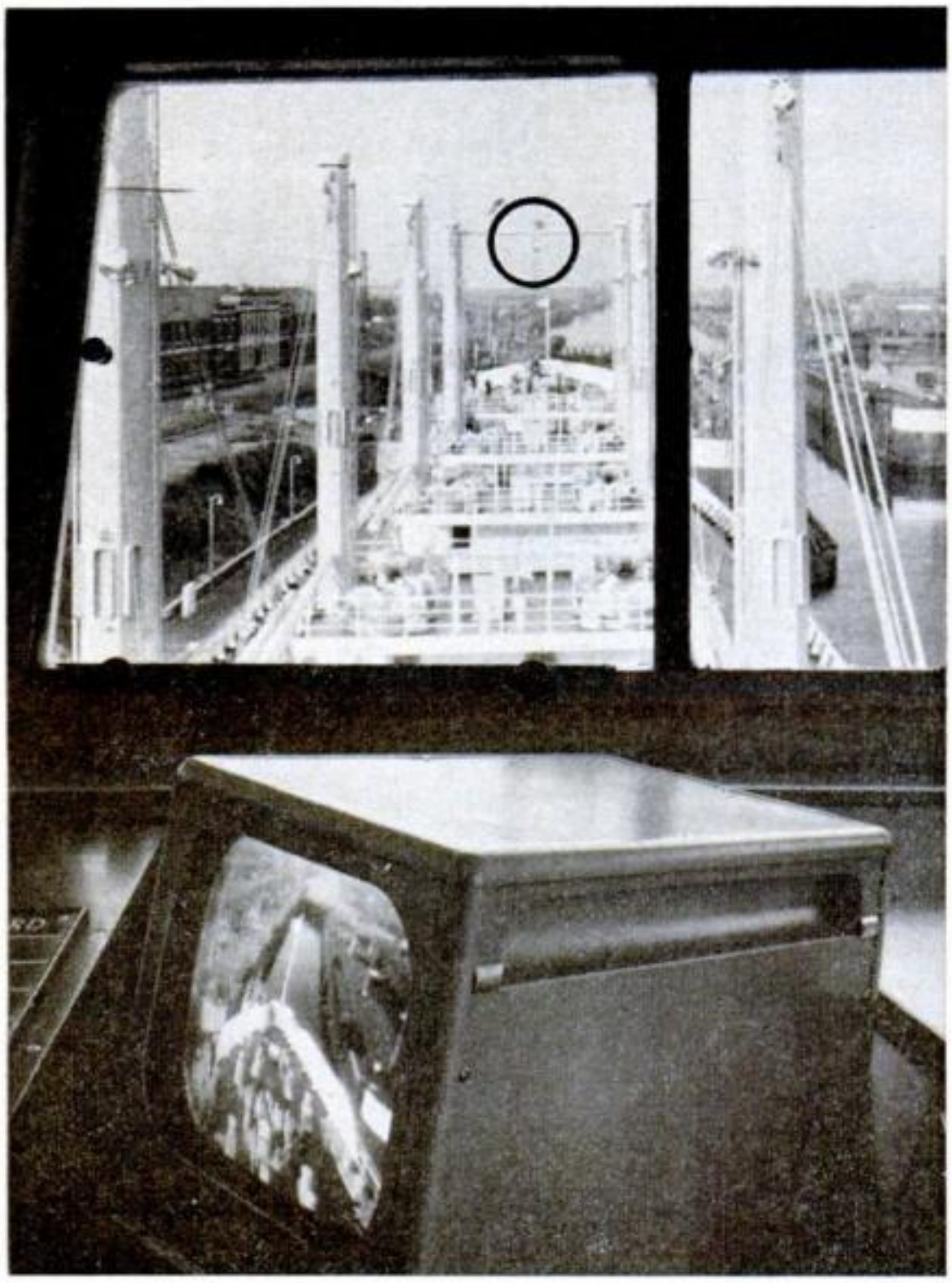

Blind area near locks shows up on Manchester Commerce's bridge TV console. Camera (circled) is at forward king posts.

Movable mount on 40-foot-high tie bar is aligned under plate above.

Engine-room controls are monitored from bridge while at sea.

Closed-circuit TV gives ships new eyes

Closed-circuit television makes for push-button operation on the semiautomated ships of Britain's Manchester Liners. In a waterproof mount hoisted 40 feet above deck between forward king posts, the TV camera assists in navigating the St. Lawrence Seaway and the narrow Manchester Ship Canal at either end of the run. Covering blind spots hidden to the bridge, it also makes precise docking possible without the aid of tugs. Flexible cable carrying the picture has additional outlets so the camera can be plugged in on deck to watch loading operations or in the engine room to keep tab on the controls.

Pan and tilt TV installed in a supertanker for a Norwegian operator swings, dips, and zooms to cover any kind of view. Japanese and Scandinavian shipbuilders are also interested.—*Hans F. Kutschbach.*

Bridge far astern on 85,000-ton British-built Borgsten navigates with aid of TV eyes on foremast.

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Milk served out of refrigerator

A disposable container keeps 10 quarts of milk in your refrigerator in the same space taken by three half-gallon bottles. The carton encloses a double-wall polyethylene bag that collapses as milk is drawn from a push-pull spigot, closing out air and keeping the milk fresh.

The container, made by Liqui-Box Corp., Columbus, Ohio, is supplied by dairies throughout the country.

Whole library in a nutshell

This latest space trick might work well with earthbound libraries. The magnifying viewer on the astronaut's knee holds 12,000 pages of microfilmed manuals, maps, and navigation data for use in the Apollo lunar spacecraft. The film is coded and indexed so a flip of a switch puts any page on the screen in 15 seconds.

Copter trainer rides air cushion

To teach beginners the rudiments of flying helicopters, the trainer at right is set on a disk kept just off the ground by a cushion of air.

The pilot can glide in any direction, and practice rotation, vertical rise and descent, tilt, and other maneuvers without danger of a fall.

Del Mar Engineering, Los Angeles, built the machine for the Army.

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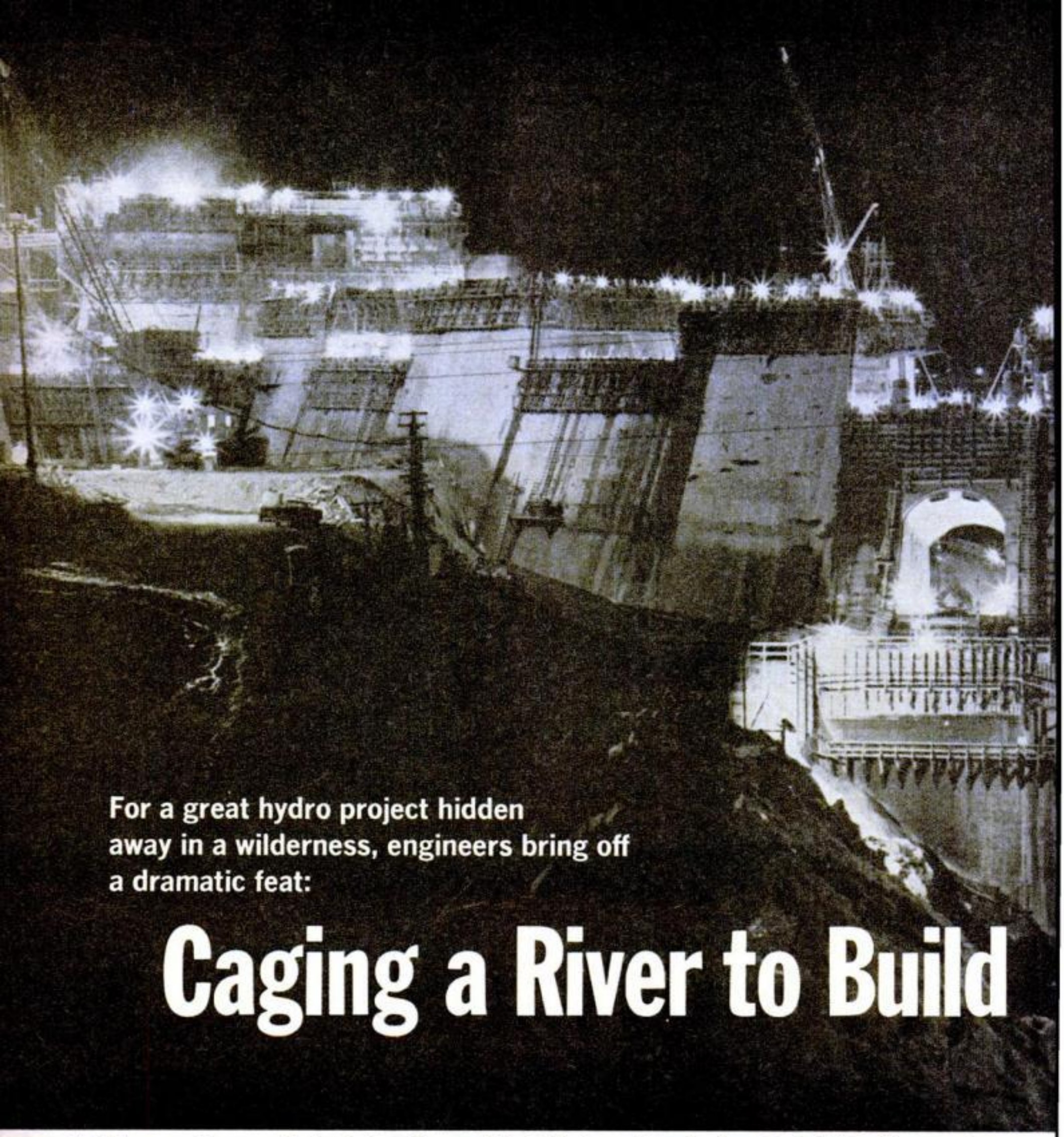

For a great hydro project hidden away in a wilderness, engineers bring off a dramatic feat:

Caging a River to Build

Builders work around clock to raise world's tallest multi-arch dam to height of more than

By John C. Rehfield

THE greatest man-made lake in the Americas is taking shape in the eastern Canadian province of Quebec. It will take eight years to fill. And it will hold enough water to flood nearly an inch deep an area the size of the whole U.S. Backing it up is the world's tallest multi-arch dam, an engineering masterpiece that rises to a towering height of more than 700 feet.

Hidden in the Canadian wilderness, almost unnoted in the news, the giant new dam and four others make up a hydro project whose $2,000,000,000 price tag ranks it as the biggest construction job going today.

A lot of juice. Some 6,000 workers and a quarter-billion dollars' worth of equipment have been thrown into a battle to wrest kilowatts from the wild

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a Skyscraper Dam

700 feet—and back up Americas' biggest man-made lake behind it, for hydroelectric power.

plunge of the Manicouagan and Outardes rivers down from the north country's highlands to the St. Lawrence. The 6,325,000 horsepower developed, far beyond the output of Niagara, will place the Manicouagan-Outardes project high among present contenders for the title of the biggest generating installation in the world.

Not only will it meet skyrocketing demands for power at home—according to long-range plans of its sponsor, Quebec's Hydro-Electric Commission, there will be plenty of current left over for transmission to U.S. cities as distant as New York.

"Manic 5"—a mile long. The program calls for three dams on the Manicouagan, two on the Outardes. Recent work has centered on the project's main dam —called simply Manic 5, for the Manicouagan's fifth upstream falls. That's the

CONTINUED

Urheberrechtlich geschütztes Material

skyscraper structure behind which the record-size lake is now forming.

The top of Manic 5 extends almost exactly a mile. The dam's huge central arch would overhang a building as tall as Chicago's Marina City.

To build Manic 5, the roaring river first had to be turned out of its V-shaped gorge. There was only one place the river could go—through the solid granite of the narrow gorge's west wall. For 2,000 feet through the rock, gangs blasted two parallel tunnels of 45-foot diameter. Together, they could carry the river's whole flow.

The big detour. Upstream from the dam site, a cofferdam blocked the channel and forced the river into the diversion tunnels. Downstream, another cofferdam kept the bypassed river from surging back. When pumps had drained the area between the cofferdams, and diggers had excavated it down to bedrock, the dam builders could begin.

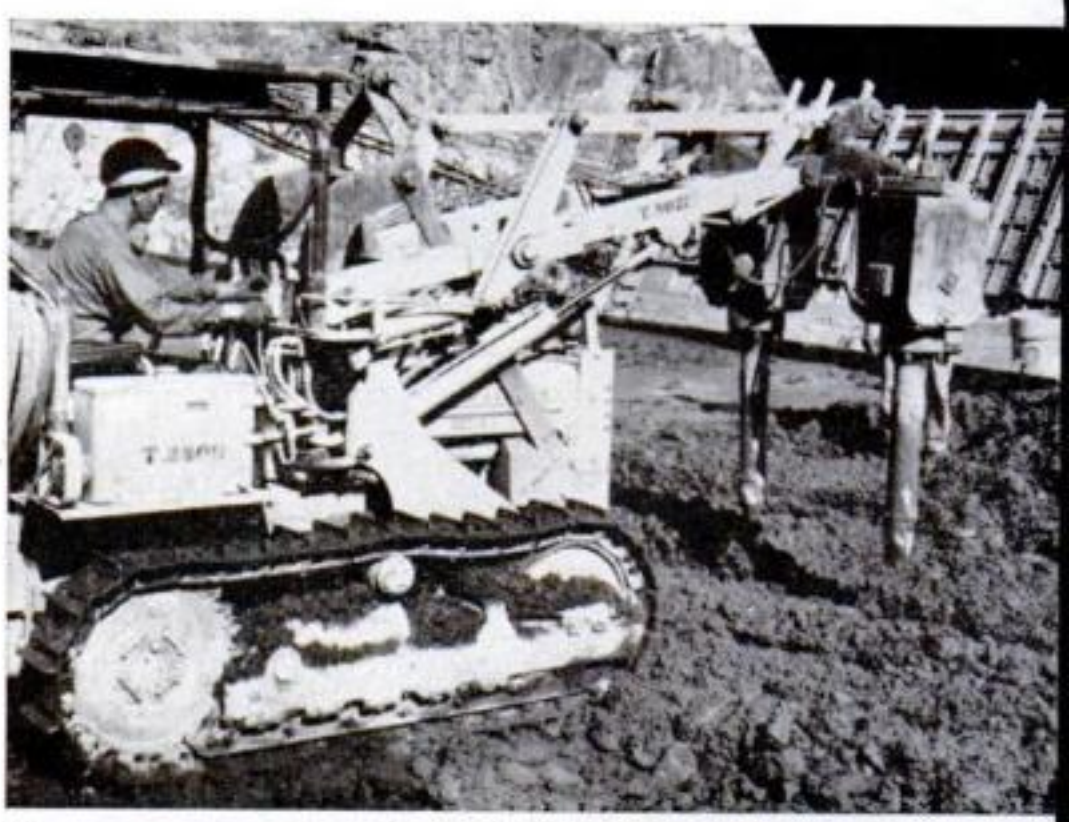
They had about 150 days—before the river would be in flood—to raise the dam past 250-foot level. With the dam at that safe height, the diversion tunnels could be plugged so the captured flood water would start to fill Manic 5's enormous pool.

They won the race against time by airlifting a million cubic yards of concrete to the job, on three sky-high cableways strung across the valley. As a bucket dropped its eight-cubic-yard load into place, a tractor with a dozer blade plowed in to level the man-high mound. Right behind it, the operator of another tractor lowered tusklike "stingers" into the fresh concrete—vibrators that buzzed angrily for a few moments to drive out air bubbles. The tractors, a bold experiment, moved and placed more concrete than unaided manpower ever could.

Hydro-Quebec's engineers still have a three-year job ahead before the first current from Manic 5 goes on the line. Then its power will flow for 350 miles to the cities of Quebec and Montreal over one of the world's highest-voltage transmission systems, a 700,000-volt line of radical new design. ■ ■

Tunnel of 45-foot diameter is one of two driven side by side for 2,000 feet through solid granite of gorge's west wall. They diverted whole river around site while Manic 5 dam was built.

Crawler-type drill, suited to mountainous terrain, aids in excavating to bedrock on which dam is to rest. Cofferdams diverted river from the site before actual building of dam began.

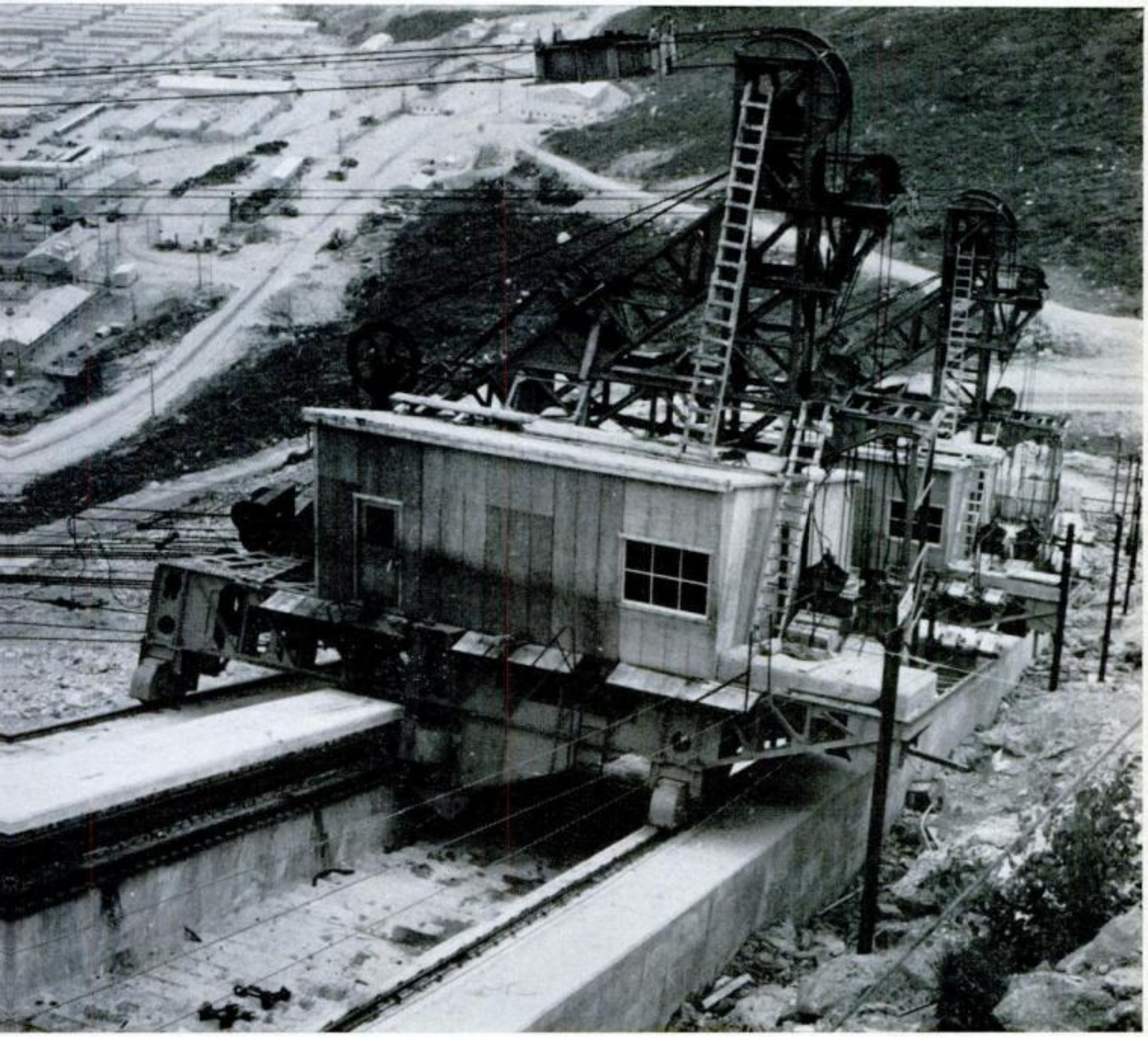


Tractor-mounted "stingers" shake down concrete freshly poured for dam, to rid it of air pockets. The tusklike devices' electric motors send high-frequency vibrations through the mix.

Urheberrechtlich geschütztes Material

Slicker-clad drillers attack rock face, sinking holes for blasting charges, as diversion tunnel advances through heart of mountain—14 feet at each shift.

"Jumbo" drilling platform enables tunnelers to wield 22 drills at once. When all holes are sunk and loaded for a blast, vehicle at left hauls the drilling platform clear of danger from flying rock.



Mobile anchorage of a cableway travels sideward on inclined rails so that bucket bringing concrete can be spotted over any part of dam. In 150 days, three cableways delivered to the dam builders a million cubic yards of concrete —enough to pave a two-lane road from New York to Washington—and airlifted odds and ends ranging from a keg of nails to a 20-ton bulldozer.

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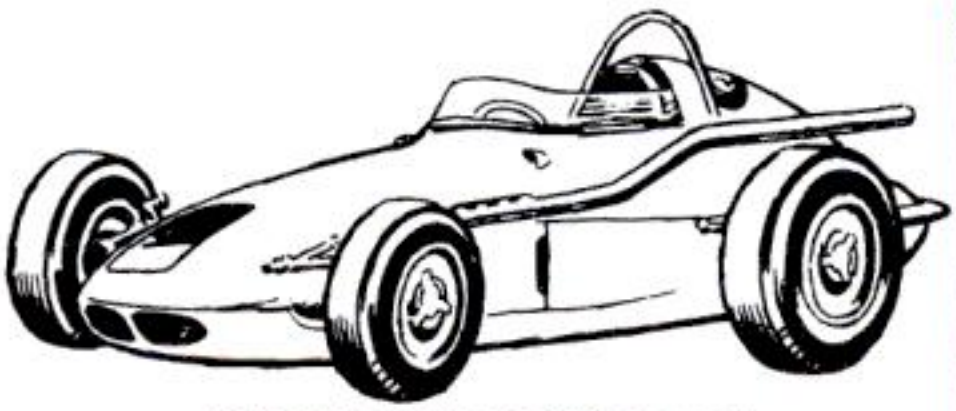
RACE CARS OF

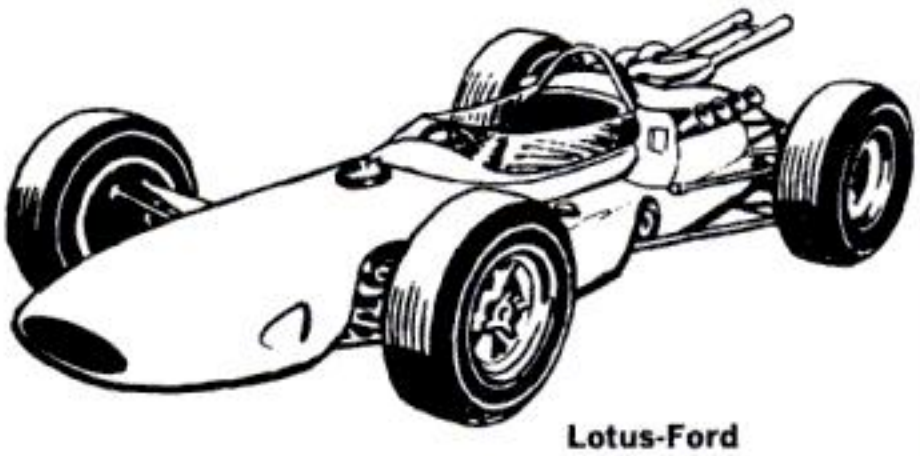
The mounts of the speed merchants will set new records in 1965

RACE cars of the world—pictured on these two pages and described in detail on the next two—will set many new records in 1965. They are better-designed. They are more stable in the corners. In some instances they are more



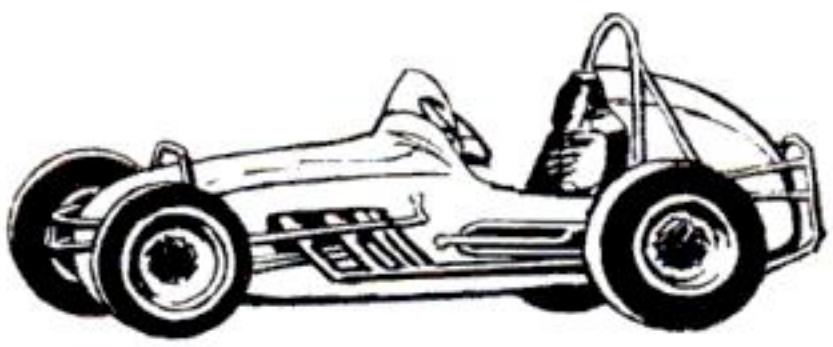
Sheraton-Thompson-Offenhauser

Ford Grand National

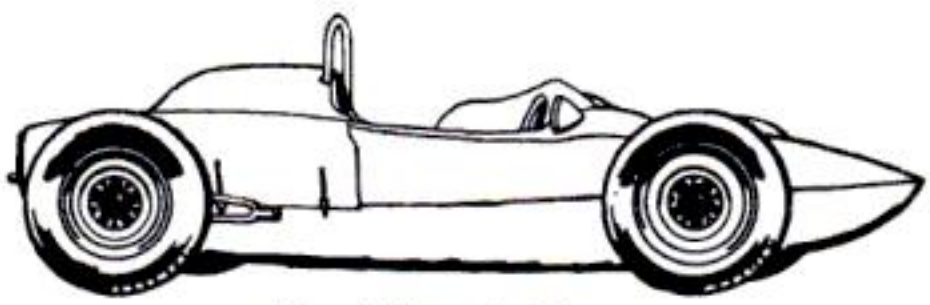


Lotus-Ford

Cobra-Ford

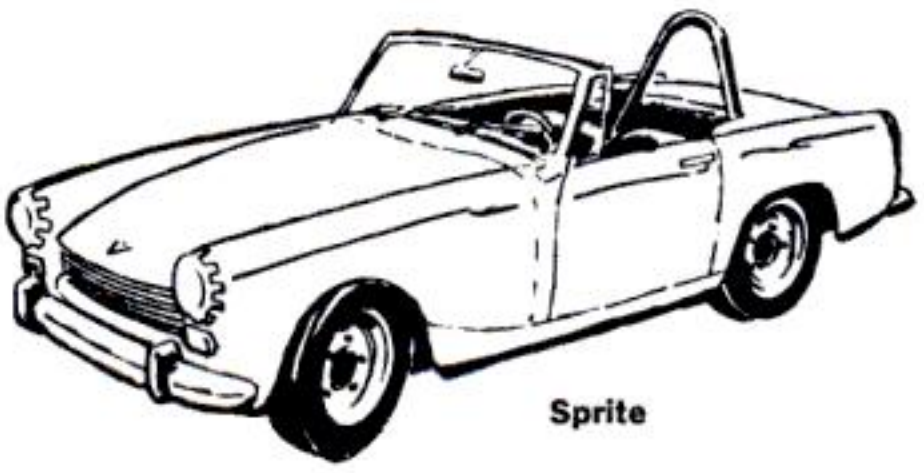


Sprint-Offenhauser



Beach Formula Vee

Midget-Offenhauser



Sprite

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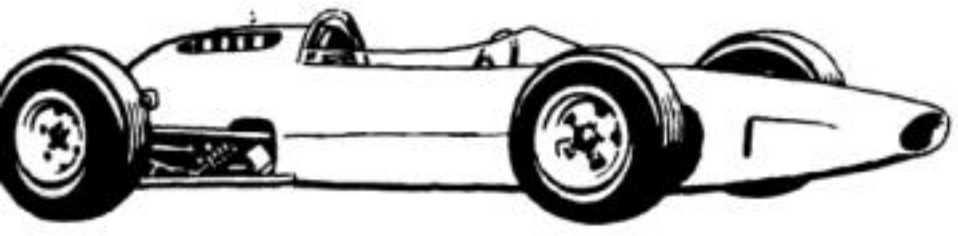
THE WORLD

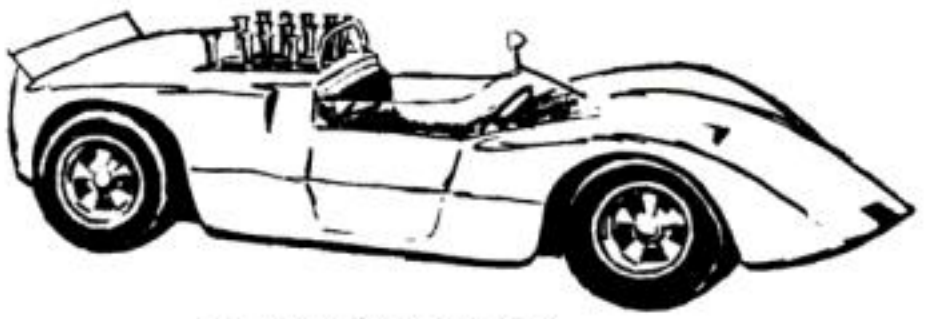
BY DAN TODD

powerful. One pointed the way in 1964 by attaining more than 200 m.p.h. at Le Mans. Formula Vees (Volkswagens) are lapping Connecticut's Lime Rock one-and-one-half mile sports-car course in a minute, 10 seconds. By previous standards, that is a remarkable performance.

Rules of the National Association for Stock Car Auto Racing are undergoing some drastic revisions—reflected in the N. A. (Not Available) entries in the POPULAR SCIENCE chart on the next pages.

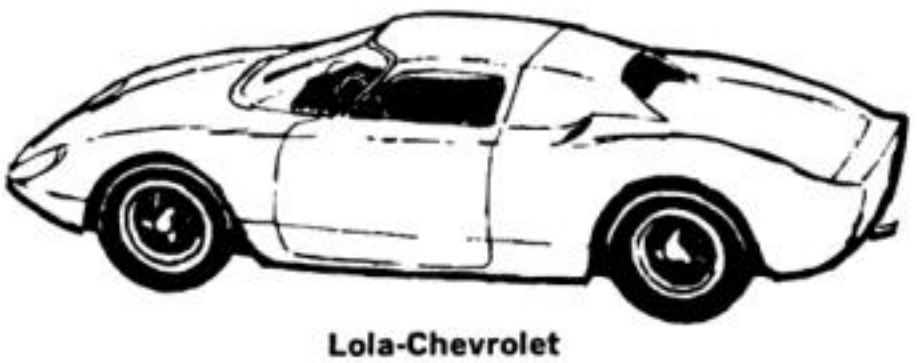


Ferrari Formula I

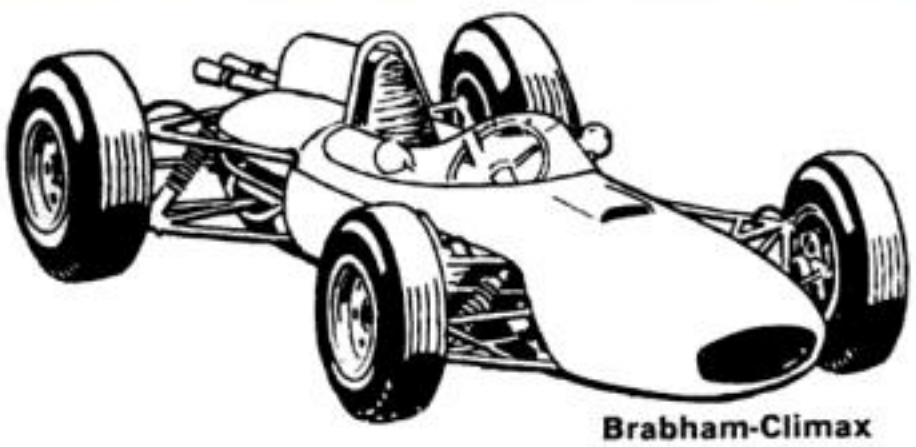


Chaparral (Chevrolet)

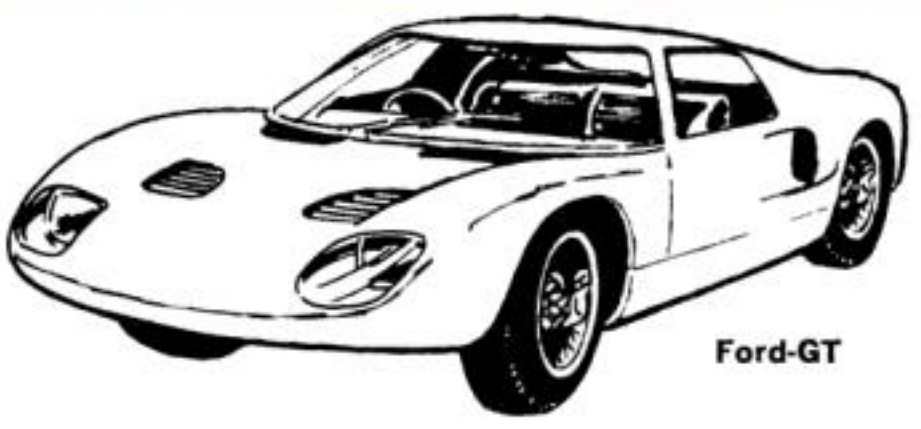
Lotus 25



Lola-Chevrolet



Brabham-Climax



Ford-GT

Ferrari 275 LM

Porsche 904

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International Race-Car Specs

REGULATING ASSOCIATION	RACING CATEGORY	DESCRIPTION OF CARS	SEATING CAPACITY	MINIMUM PRODUCTION REQUIREMENT	MAXIMUM ENGINE CAPACITY: PUSH-ROD ENGINES[1]	MAXIMUM ENGINE CAPACITY: OVERHEAD CAMSHAFT, PRODUCTION BLOCK	MAXIMUM ENGINE CAPACITY: SUPERCHARGED, PRODUCTION BLOCK
USAC	Championship Div. (Indy)	Open-wheeled race cars[2]	1	None	4,200 cc. (256.3 cu. in.)	4,200 cc. (256.28 cu. in.)	3,650 cc. (222.6 cu. in.)
	Championship Div.				5,000 cc. (305.1 cu. in.)		
	Sprint Cars				5,000 cc. (305.1 cu. in.)		3,300 cc. (201.3 cu. in.)
	Offy 110				2,450 cc. (150 cu. in.)	1,800 cc. (109.9 cu. in.)	1,640 cc. (100 cu. in.)
	Stock Car[5]	U.S. sedans, '63-'65	4-6[4]		7,013 cc. (428 cu. in.)	OHC not permitted	5,000 cc. (305.1 cu. in.)
NASCAR[5]	Grand National Championship	U.S. sedans, '63-'65		5,000	428 cu. in.	OHC not permitted	Supercharging not permitted
	Sportsman	U.S. sedans, '36-'65			330 cu. in.		
	Limited Sportsman, '36-'65	Same as above unless track rule intervenes					
	Modified	U.S. sedans, '36-'65	Stock		Free	Free	Free
	Late Model Modified	U.S. sedans, '49-'62		5,000	Free	N.A.	N.A.
	Hobby	U.S. sedans, '36-'65			318 cu. in.	N.A.	N.A.
	Cadet	U.S. sedans, '36-'65			N.A.	N.A.	N.A.
FIA[6]	Formula I	Open-wheeled race cars	1	None	1,000 cc. (61 cu. in.)	1,500 cc. (91.5 cu. in.)	Supercharging not permitted
	Formula II					1,000 cc. (61 cu. in.)	
	Formula III	GT				OHC not permitted	
	Formula Libre (Formula Course)	GT	1	None	For Formulas I, II, III	Free	Free
	Touring, Group I (production)	1 Prod. cars open or closed 4 years old or less	2 to 4	1,000	400 cc. (24.4 cu. in.)	Same as push rod	Multiply capacity by 1.4 to determine competition class
		2			500 cc. (30.5 cu. in.)		
		3			600 cc. (36.6 cu. in.)		
		4			700 cc. (42.7 cu. in.)		
		5			850 cc. (51.8 cu. in.)		
		6			1,000 cc. (61 cu. in.)		
		7			1,150 cc. (70.1 cu. in.)		
		8			1,300 cc. (79.1 cu. in.)		
		9			1,600 cc. (97.6 cu. in.)		
		10			2,000 cc. (122 cu. in.)		
		11			2,500 cc. (152.5 cu. in.)		
		12			3,000 cc. (183 cu. in.)		
		13			4,000 cc. (244 cu. in.)		
		14			5,000 cc. (305 cu. in.)		
		15			Over 5,000 cc.		
	Touring, Group II (improved)	Group I plus older cars		100	Same classifications as Group I		
	Grand Touring, Group III	Stock, modified, and custom bodies[9]					
	Sports Cars	Same as GT, and specials		None			
SCCA	Production, A-H	Prod. cars, open or closed	2 to 4	100	Stock, 3/64 overbore permitted	Same as push rod	With supercharger, car competes in next-higher engine-size class
	Modified Category	C D E F G H Specially built closed-wheel race cars	2 to 4	None	Over 3,000 cc. 3,000 cc. (183 cu. in.) 2,000 cc. (122 cu. in.) 1,600 cc. (97.6 cu. in.) 1,150 cc. (70.1 cu. in.) 850 cc. (51.8 cu. in.)	Same as push rod	With supercharger, car competes in next-higher engine-size class
	Formula SCCA						
	A	Open-wheeled race cars	1	None	3,000 cc. (183 cu. in.)	3,000 cc.	Supercharging not permitted
	B (Recognized by FIA as Touring or GT cars)				1,600 cc. (97.6 cu. in.)	1,600 cc.	1,600 cc.
	C				1,100 cc. (67.1 cu. in.)	1,100 cc.	Supercharging not permitted
	Formula Vee	Open-wheeled race cars	1	None	1,192 cc. (72.6 cu.in.)	Standard VW engines only	Supercharging not permitted

NOTES: [1]NASCAR and USAC require American production blocks. [2]Must also have an open cockpit. [3]No hemi-heads or high-risers allowed. Many items noted as "free" (nothing in the rule books governing them) are nonetheless subject to scrutiny for safety of design and condition. [4]All seats are removed from cars in NASCAR and USAC events. Passenger compartment is greatly reinforced and steel-tube-enclosed seat installed for driver. [5]NASCAR and USAC cars must retain appearance of stock cars. [6]Filling-station grades.

MAXIMUM ENGINE CAPACITY: OVERHEAD CAMSHAFT, SUPERCHARGED	GEARBOX (Number of forward speeds generally used)	ENGINE MODFICATIONS ALLOWED	FUEL	TIRES	WHEELS (Minimum diameter)	RIM (Minimum width)	MINIMUM WEIGHT (Pounds)	MUDGUARDS	LIGHTS	WHEELBASE (Minimum)	TREAD (Minimum)
2,800 cc. (170.8 cu. in.)	1	Free[3]	Free	Approved only	15″	9½″	Free	Not req.	Not req.	96″	47″
					15″	9½″				96″	47″
					15″	9½″				84″	47″
1,250 cc. (76.2 cu. in.)					12″	Free				Free	
Not permitted	3	Factory options		Racing 8.90 max.	Stock			Stock	Removed and covered	116″	Stock
Supercharging not permitted	Stock 3-4 No dog clutch	Anything inside, same cap.	F.S.G.[4]	No slicks; same size, brand	14″-15″	8½″ max.	N.A.	Stock	Removed and covered	N.A.[7]	1″±
			F.S.G.	Free	Free		Free	½ width of tread		109″ min.	Stock Free
Same as above unless track rule intervenes											
Free	Any 2F 1R	Special heads	Free	Free	Free		Free	½ of tread	Removed and covered	109″ min.	Free
N.A.		Any cam, bore	F.S.G.	Slicks right, std. left	Free	8½″ max.	Free	Full		115±1″	Free
N.A.	Stock	Any cam, .06″ overbore	F.S.G.		Free		Free	½ of tread		109″ min.	Free
N.A.			F.S.G.		Free		Free	½ of tread		109″ min.	Free
Supercharging not permitted	4-6	Free	F.S.G.	Free	Free		991	Not req.	Not req.	Free	
							924			Free	
							880			78.7″	43.3″
Free	4-6	Free	F.S.G.	Free	Free		Free	Not req.	Not req.	Free	
Multiply capacity by 1.4 to determine competition class	3-4	Minimal	F.S.G.	Free	Stock-size factory options allowed		Stock	Must cover ⅓ circumference of wheels and attach to body (no cycle fenders)	Required	Stock	
		Free		No tubeless, no slicks	All equal		Free			Free	
With supercharger, car competes in next-h'gher engine-size class	4-5	Minimal	F.S.G.	Conform to SCCA specs	Stock	Optional	Stock	Stock	Required	Stock	
With supercharger, car competes in next-higher engine-size class	4-5	Free	F.S.G.	Right and left same			Free	⅓ (see above)	Required	Stock	
Supercharging not permitted	Free	Free except as specified	F.S.G.	Free	Free		1,105				
1,600 cc.	5 max.	Minimal	F.S.G.	Free	Stock		848	Not req.	Required	Free	
Supercharging not permitted	Free	Free except as specified	F.S.G.	Free	Stock		750				
Supercharging not permitted	4	Minor	F.S.G.	Free	15″	Stock	825	Not req.	Required	81.5″	51.4″

[7]119-inch minimum required on Daytona, Atlanta, Darlington, Charlotte tracks. 119-inch models can compete in any Grand National race, but cars below 119 and not shorter than 116 are restricted to shorter courses. [8]FIA rules govern events on the international calendar. [9]100 series production cars (complete) must have been produced before chassis of such car may be entered with a custom body. Custom car must conform to factory specs on weight. N.A.: Information not available at this time.

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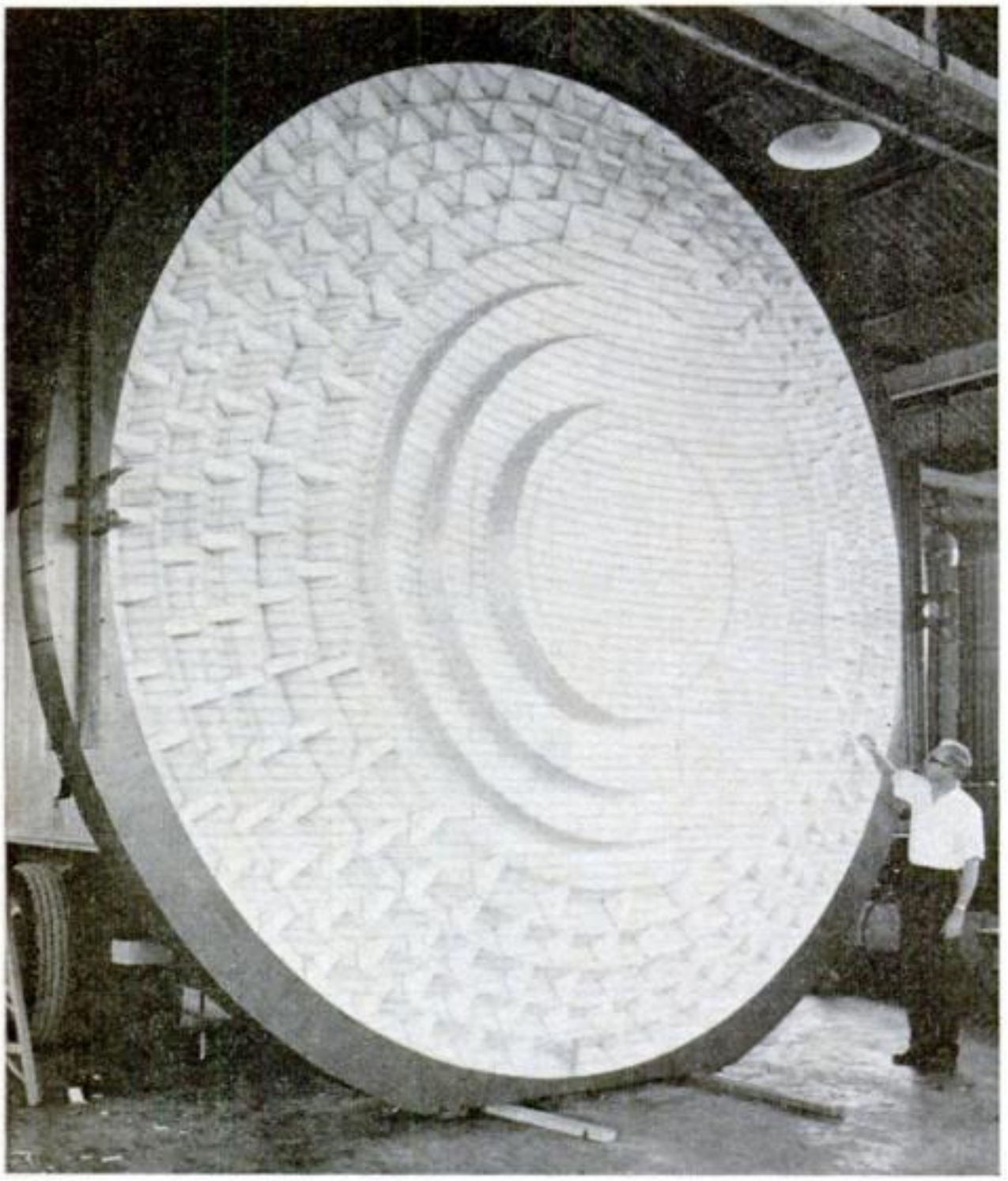

Radar antenna picks up blip of mile-high fly

This radar antenna with an aluminum-foil lens, largest of its type, can detect a fly one mile away. Built by University of Texas engineers, it focuses a pencil-like 3,300-megacycle radio beam. With it and a smaller, higher-frequency antenna of the same kind, experts hope to identify "angel echoes," mysterious radar reflections now thought to be high-flying birds, or insects, or atmospheric phenomena.

Plastics helps strike up the band

Next time you hear a college or high-school marching band, look for the wraparound sousaphone. If it's gleaming white instead of brass, it's made of fiberglass.

Substituting plastics for metal, C. G. Conn Ltd., Elkhart, Ind., cut weight from 30 pounds to under 17. Scratch-proof and rugged, the horn is said to lose nothing in tone.

He-man-size patio chess

Latest in chess for outdoors is the giant set at right. Molded of plastic, the pawns are 11 inches high, the kings 21 inches. Each piece weighs about a pound, but they can be filled with sand if high wind is a problem. Kerrco, Inc., Lincoln, Nebr., suggests setting them on patio or recreation-area tiles alternating in color like a chessboard. The chess pieces come in gold and silver.

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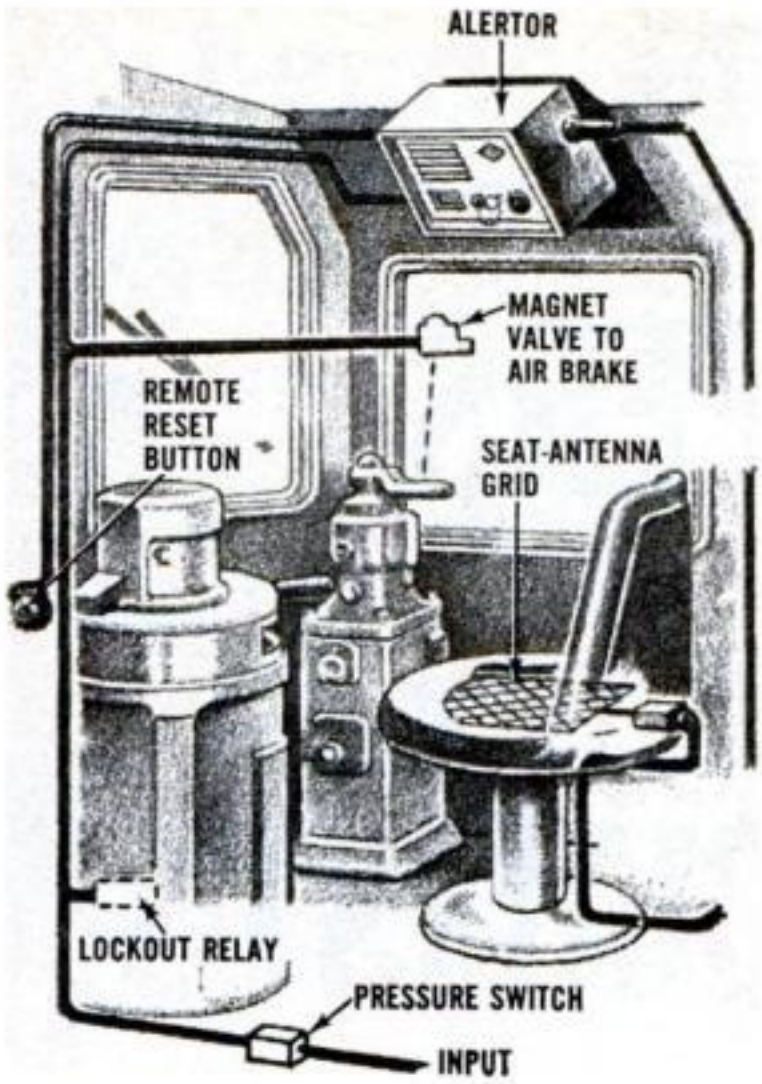

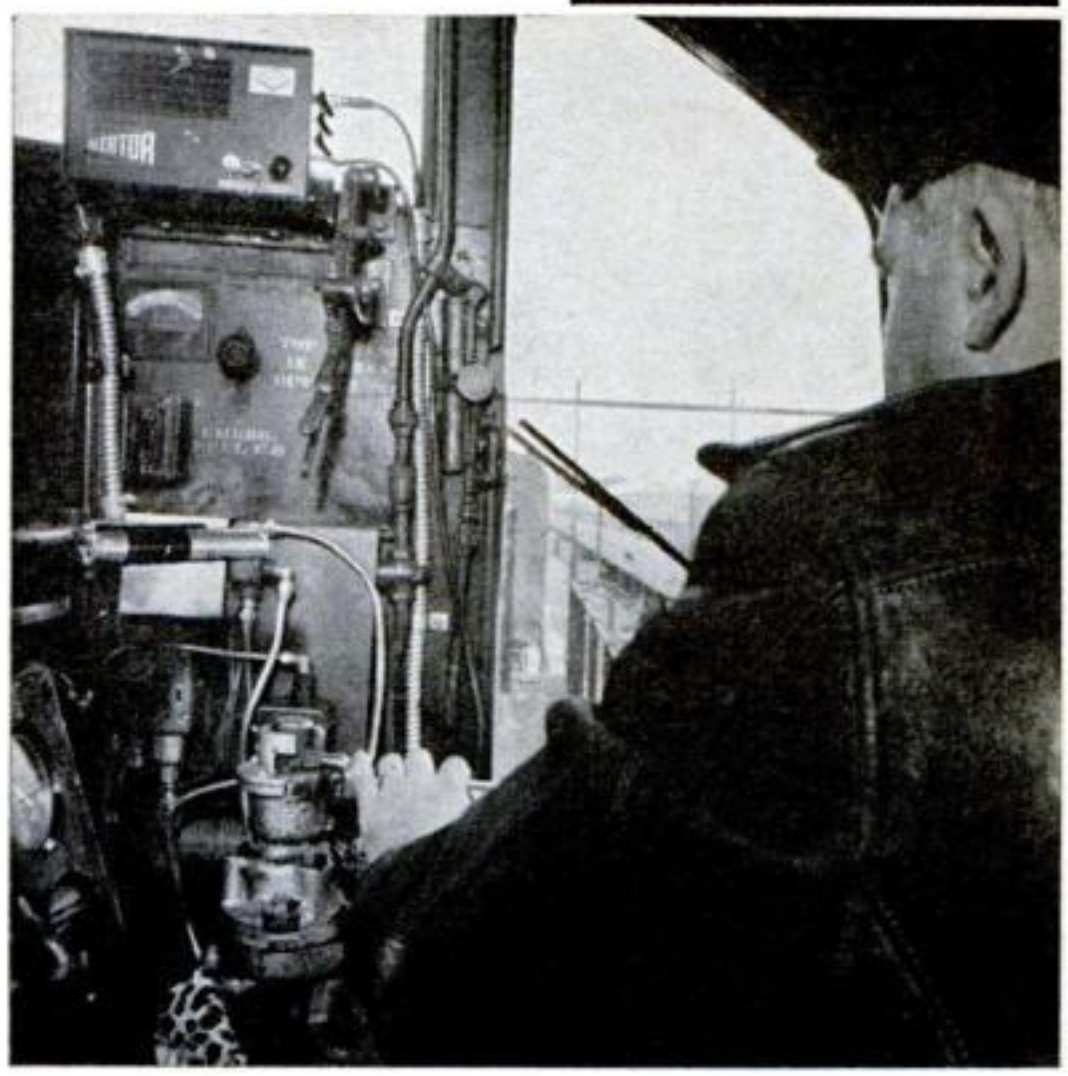

Electronic deadman control stops train automatically

A little black box in the engineer's cab and an antenna grid built into his seat may be the means some day of keeping you from being in a bad train wreck.

The box contains an electronic alertness device. Connected to the seat grid, it senses the normal movements made by the engineer—controlling the throttle and brakes, touching metallic objects inside the cab, and getting into or out of his seat. If the engineer doesn't move for a full 20 seconds, it flashes a warning light or sounds an alarm; if he still doesn't move, it puts on the brakes.

The electronic deadman control, called an Alertor, is made by Vapor Corp., Chicago. It has been installed in engines on a score of railroads, including the Burlington, Illinois Central, Rock Island, Santa Fe, and Southern Pacific.

Stiff-necked camel wears splints

A blow on the neck from another camel severely damaged tendons, separated vertabrae, and almost proved fatal by stretching the spinal cord of this fellow at the zoo in Columbus, Ohio. Veterinarians came to the rescue with homemade splints cut from plywood, padded, and bolted in place.

Tiny farm tractor bends in middle

Steering was simplified on a Czech-built farm tractor by using two chassis sections with a swivel pin at the central steering box and a universal pin at the central axles. The tractor can turn in its own eight-foot length. The controls and steering column are on the rear section.

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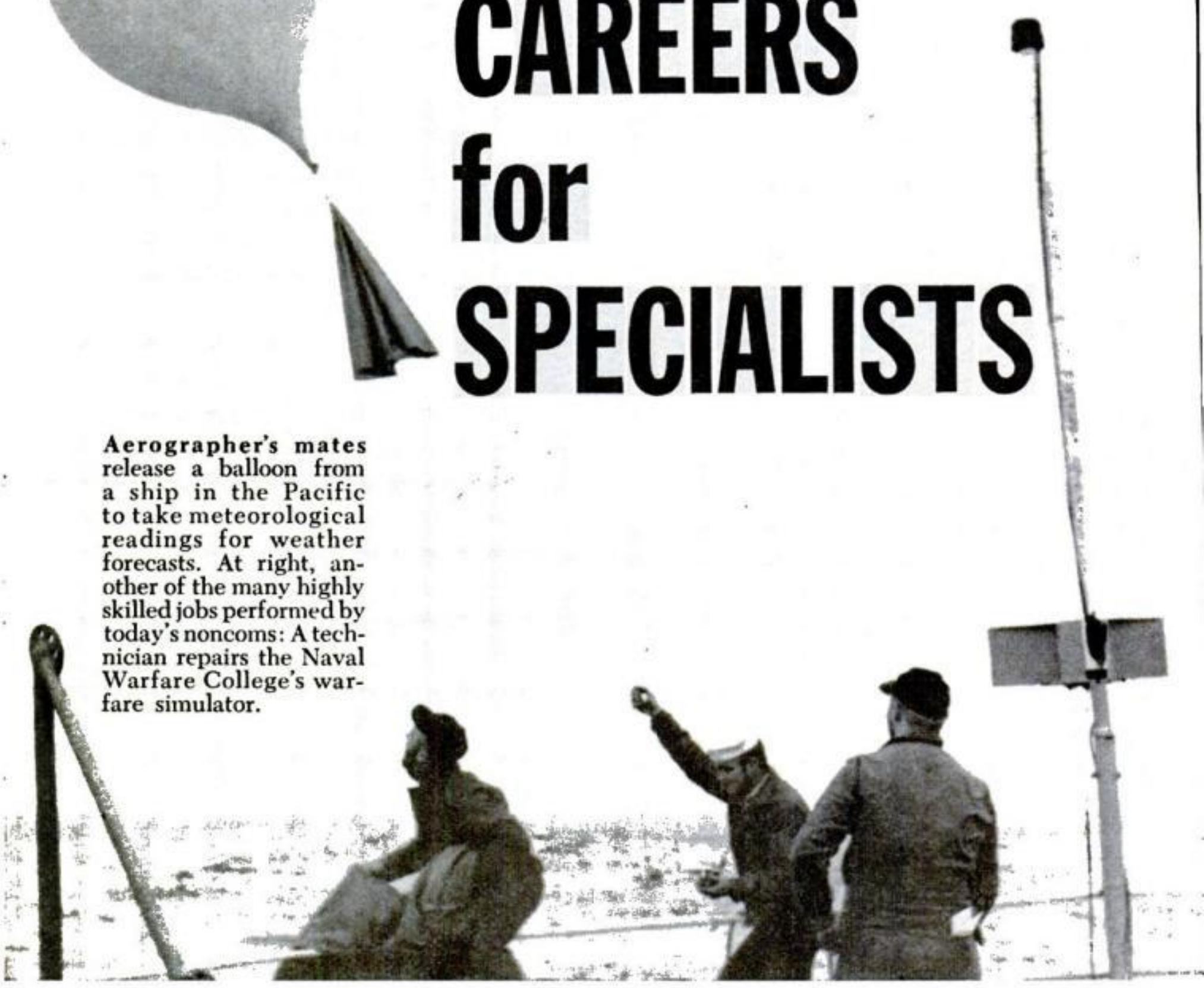
How the Armed Forces Create CAREERS for SPECIALISTS



Aerographer's mates release a balloon from a ship in the Pacific to take meteorological readings for weather forecasts. At right, another of the many highly skilled jobs performed by today's noncoms: A technician repairs the Naval Warfare College's warfare simulator.

By Stanley L. Englebardt

TODAY'S service noncoms not only step smartly, but also think smartly. You can find many members of this group controlling missile-firing systems, operating water-purification and distribution plants, deciphering Chinese or Russian code messages, maintaining liquid-oxygen or nitrogen plants, assisting on surgical teams, or performing other highly skilled jobs.

These specialists are among the best educated and most skilled people this country has. What are your chances of joining this elite group?

Very good—provided you are between 18 and 30, in good health, have a good basic educational background, are willing to apply yourself to some stiff courses, and have the ability to win out over tough competition.

If you enlist, the services guarantee a choice of vocational training programs —with two conditions:

1. That changes in equipment or

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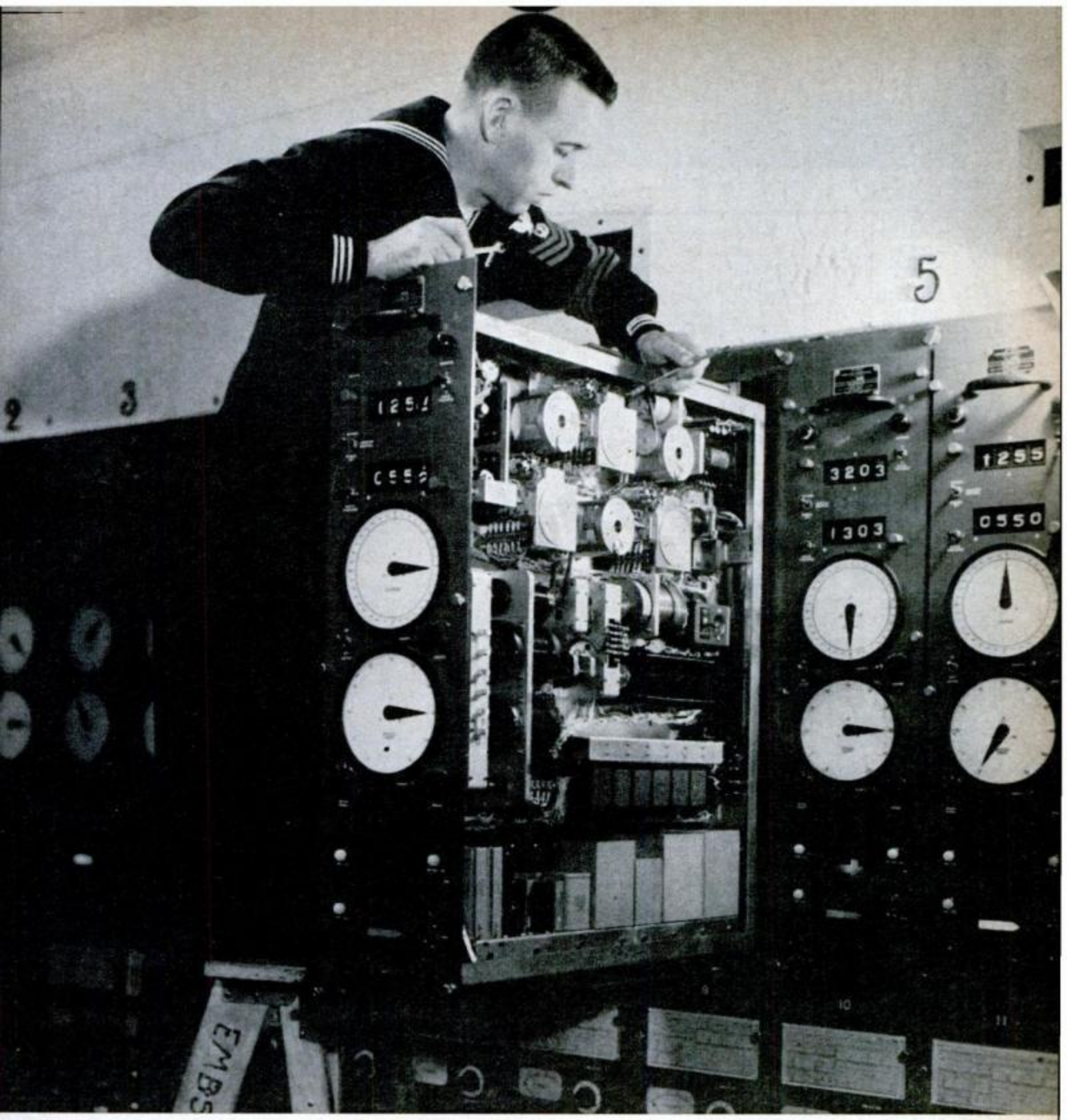

weapons do not make the skills you want to acquire obsolete or alter the need for them.

2. That there are enough openings for those who apply.

Passing the tests. If openings are limited, which applicants get the nod? First choice usually is made on the basis of aptitude and education. The services use written, oral, and dexterity tests, given after enlistment, to determine your qualifications. Air Force policy permits high-school seniors to take some of these tests before enlistment. The test results give you an idea of where your skills lie —but they don't guarantee you a vocational opening.

As for education, first choice always goes to high-school graduates or college men. The dropout has little more chance of getting ahead on the technical side in the armed forces than he has in private industry.

Let's assume that you're *in*. Where do you go from there? When does actual technical training start? What are the

CONTINUED

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Careers for Armed Forces Specialists

Here are a few of the skills taught by the armed forces. These examples give you an idea of the duties and responsibilities of the job, qualifications needed, and promotion potentials.

	SKILL	DUTIES	QUALIFICATIONS	PROMOTION POTENTIAL
ARMY	AIRBORNE RADAR SPECIALIST	Performs preflight checkout and maintenance on airborne radar	H.S. or trade-school courses in basic electricity or electronics. Or practical experience in that work	E-5 Sgt.
ARMY	BALLISTIC MISSILE REPAIRMAN	Inspects, tests, and performs depot maintenance and repair of missile-guidance systems	Courses in algebra, trigonometry, physics, electricity, electronics, automotive mechanics. Or equivalent practical experience	E-8 1st Sgt.
ARMY	TRACK VEHICLE MECHANIC	Performs maintenance on track, amphibious tracked, wheeled, and amphibious-wheeled vehicles	H.S. math, physics, automotive mechanics, or practical automotive shopwork experience	E-8 M/Sgt.
ARMY	DENTAL LAB SPECIALIST	Fabricates, constructs, and repairs prosthetic appliances and performs laboratory procedures	Math, physics, chemistry, or machine-shop or woodworking courses, or experience in patternmaking and similar crafts	E-8 M/Sgt.
NAVY	AEROGRAPHER'S MATE	Collects, records, and analyzes weather information	H.S. algebra, trigonometry, physics, physiography, or practical meteorological experience	E-4 to E-9 Petty Officer
NAVY	DATA SYSTEMS TECHNICIAN	Maintains, operates, and supervises electronic data-processing systems	H.S. physics, algebra, trigonometry. Better-than-average ability to solve arithmetic problems involving binary numbers	E-9 M/Chief up to Warrant Officer
NAVY	ENGINEMAN	Operates, maintains, and repairs internal-combustion engines	Above-average learning ability and use of numbers. Background in shop courses and practical shop mathematics	E-4 to E-9 Petty Officer
NAVY	PHOTOGRAPHER'S MATE	Operates, maintains, and repairs various types of cameras for ground and aerial photography. News photography, microfilming, and film processing	H.S. physics and chemistry. Photo hobby. Above-average ability in numbers problems.	E-4 to E-9 Petty Officer
NAVY	ILLUSTRATOR-DRAFTSMAN	Designs and prepares drawings and illustrations for presentation and reproduction	H.S. mathematics and art courses —skill in freehand drawing	E-9 M/Chief up to Warrant Officer
AIR FORCE	LANGUAGE	Translates written material and interprets	H.S. foreign-language courses, English composition, mathematics. Above-average scores on aptitude tests	E-9 Chief M/Sgt.
AIR FORCE	CARTOGRAPHER	Constructs maps, aeronautical and target charts	Excellent eyesight, superior manual dexterity, H.S. math	E-9 Chief M/Sgt.
AIR FORCE	SAFETY TECHNICIAN	Conducts safety programs, analyzes accidents, investigates hazardous conditions	H.S. courses in algebra, plane geometry, trigonometry, physics, electronics, and general science—knowledge of statistics	E-9 Chief M/Sgt.
AIR FORCE	STEWARD SUPERVISOR	Supervises and operates mess facilities	Manual dexterity. Knowledge of dietetic principles, menu-planning, food, sanitation	E-9 Chief M/Sgt.
AIR FORCE	EDUCATION INSTRUCTOR	Instructs in academic and general military subjects	Completion of a wide range of academic subjects, plus ability to speak in public and create training aids	E-9 Chief M/Sgt.

schools like? What about salary, benefits, and so forth? How long will it take before you can start sewing stripes on your sleeve?

First stop in all services is basic training—six to nine weeks of learning purely military skills. You'll enter with the pay grade E-1—Buck Private, Airman Recruit, or Seaman Recruit—at $78 a month. After four months, you'll be moved up to E-2 at $85.80 a month.

After basic, you're assigned to a unit for on-the-job training in your chosen specialty. After a minimum of three months in grade, you're promoted to

[*Continued on page 214*]

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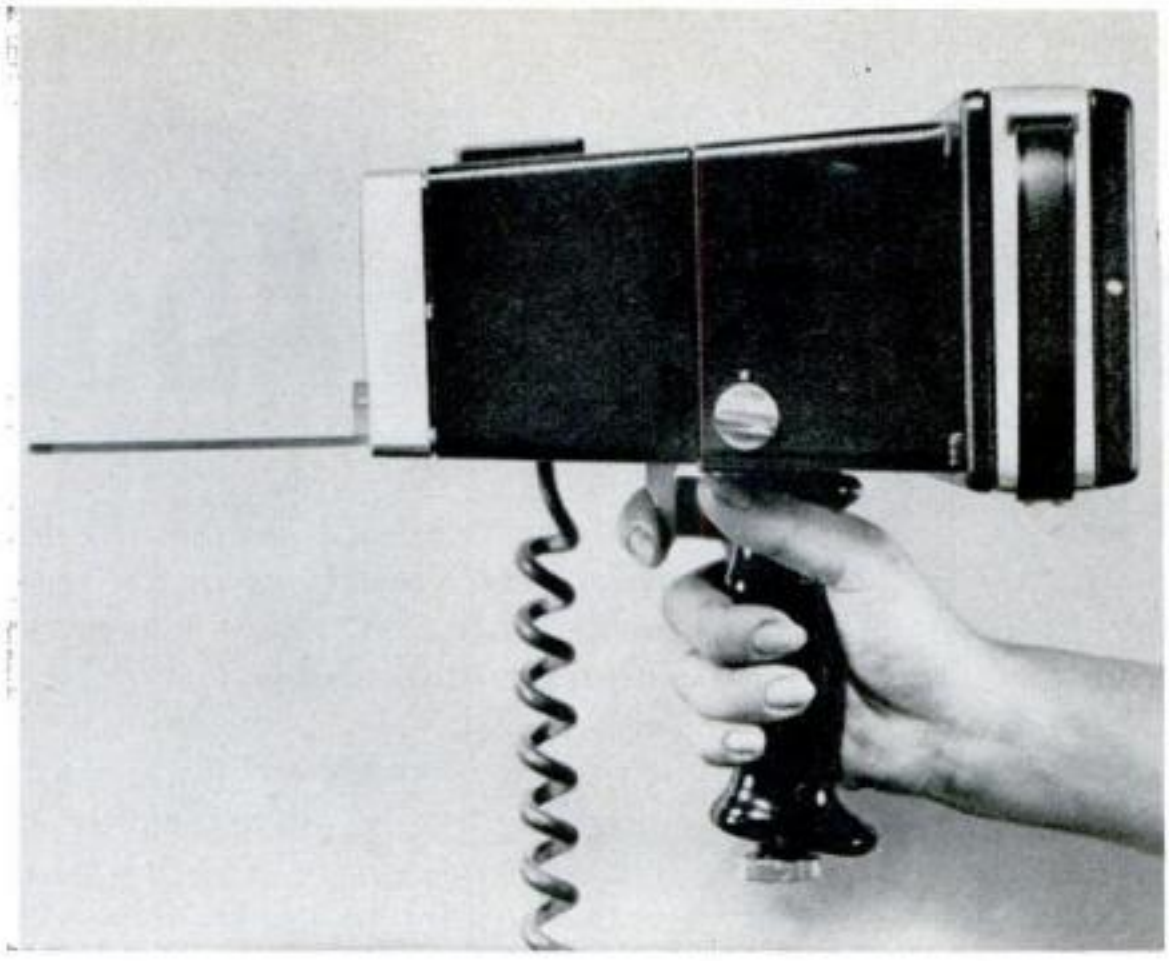
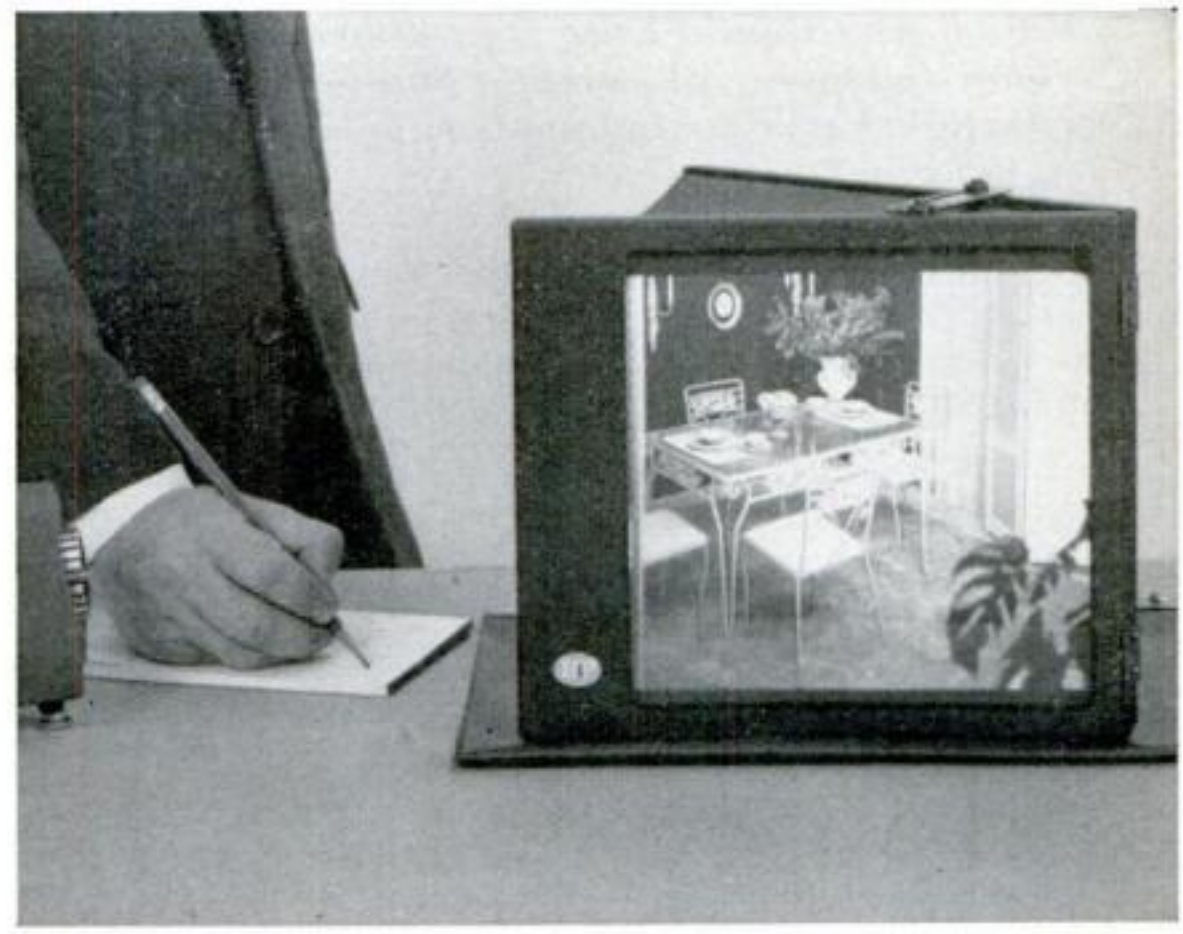


New Polaroid Camera Makes Instant Close-Ups

Life-size, one-quarter life-size, or double life-size pictures of small objects can be made instantly and almost automatically with this new Polaroid camera. Photos can be either color or black and white. No focusing or exposure adjustments are needed to repeat results from one occasion to the next. The camera can be hand-held for all types of close-ups. It has a built-in electronic-flash ring light on the shutter housing. Prices start at about $225 for the basic camera and lens.

CdS meter has 9-degree angle of acceptance

The narrow angle of this new reflected-light meter lets you make close-up light readings from a distance. You simply look through the meter's viewfinder and a circle shows area measured. The Minolta Viewmeter 9 is now on sale in stores. Price: $54.95.



Rear projection screen fits into briefcase

Any projector—movie, slide, filmstrip, or microfilm—can be used with this miniature fold-up screen. The "black" Plexiglass screen is eight inches square and can be comfortably viewed by six people. The Groupshow Mini's folding hood keeps room lights from washing out the picture. Hudson Photo Industries, Irvington, N.Y. $25.

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PS PHOTOGRAPHY

A's to Your Q's About

By Hubert Luckett

Q ***Is there a simple rule for figuring correct exposure for night shots when I can't get a meter reading?***

A In the strictest sense, there is no "correct" exposure for night pictures. But there is a wide range of exposures that will yield pleasing—though different—results. For a starting point, remember the basic exposure of 8 seconds at f/8 with film rated at ASA 64. Bracket this exposure with one at ¼ the amount and one at four times it, and most of the time you'll get a pleasing picture. Although some very dim night scenes may require as much as two or three minutes, it's a fact that more night pictures are ruined by overexposure than by underexposure.

Q ***Which film should I use for outdoor color pictures at night, outdoor (daylight) type or indoor (artificial-light) type?***

A Beautiful night pictures have been made on both types. Color films balanced for artificial light will render the colors more nearly as the eye sees them, but daylight film gives a warm, orangy glow that is very effective with some subjects.

Q ***If I know the exposure for a film with one ASA rating, say 64, how do I translate this to the correct exposure for another film with a different ASA number, such as 160?***

A Exposure times are directly proportional to the ASA numbers. In the example: 64 is two-fifths of 160, so you would reduce your exposure to two-fifths. Practically, it would be close enough to reduce an eight-second exposure to three seconds or change the f number about 1⅓ stops—that is, close the lens aperture from f/8 to about one-third stop past f/11.

Q ***What does "speed" mean in photography? Obviously it can't mean the same thing it does when you talk about automobiles.***

A If you're a newcomer to photography, this is a puzzling bit of photographic jargon you'll have to learn to accept. There are at least three different kinds of "speed": *Shutter speed* refers to the length of time the shutter is open. *Lens speed* is the light-gathering power of a lens. *Film speed* is the measure of a film's sensitivity to light.

Q ***I can see how a shutter speed of 1/100 of a second is faster than 1/25, but what makes one lens faster than another?***

A A lens is "faster" than another if it passes more light in a given period of time. Lens speed is designated numerically by f numbers, which are simply the ratio of lens-opening diameter to focal length (the distance between lens and film when the image is sharply focused). If the lens opening is ½ inch in diameter and the focal length is 2 inches, the f number is: $2 \div \frac{1}{2} = 4$—usually written f/4.

Q ***It's not hard to see that light will pour through a bigger hole faster than through a smaller one, but how about film speed? Why are some films called faster than others?***

A A certain quantity of light must fall on any film to form a developable image. The more sensitive the film, the less light it takes to produce an image. A more sensitive film will be correctly exposed by a particular intensity of light in less time than a less sensitive one, and is thus "faster."

Q ***My friends tell me that stopping down the lens and using a slower shutter speed will give me sharper pictures. Is this true?***

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EXPOSURE

A No. This is a half-truth widely believed by amateurs. They are fooled by the fact that a smaller stop gives greater apparent depth of field—when the lens is focused to give a sharp image of a particular object, other objects closer or farther away do not appear equally sharp. But there is a zone in front of and behind the focused object where the loss in sharpness is so slight it is scarcely noticeable. The smaller the stop, the greater this zone of acceptable sharpness. But sharpness of the objects at the focused distance is actually degraded progressively as you go to stops smaller than f/8 on most lenses. Modern lenses usually give the sharpest image when they are stopped down two stops from their maximum aperture.

Another factor: Camera shake degrades sharpness. Controlled tests have shown that most photographers are overly confident of their ability to hold the camera steady. It is practically impossible to get maximum sharpness in a hand-held shot at shutter speeds below 1/200 second.

Q ***How can I quickly determine the relative exposure values of two widely separated stops?***

A They are proportional to the squares of the f numbers. Suppose you want to switch from f/32 to f/2. The square of 32 is 1,024; the square of two is four. Divide 1,024 by 4 and you get 256. This tells you that at f/2 you get 256 times more light through the lens than at f/32. If one second was your correct exposure at f/32, you would use 1/250 of a second at f/2. The standard f stops, incidentally, are 2, 2.8, 4, 5.6, 8, 11, 16, 22, and so on. Exposure values decrease by half at each stop.

Q ***What is a guide number?***

A It's a number used to arrive at the correct exposure for a subject lighted by a flood, flashbulb, or electronic flash. Manufacturers publish approximate guide numbers for their products, but there are so many variables involved it's better to determine your own.

Q ***How do you find your own guide numbers?***

A Set up the light source exactly 10 feet from an average subject. Take a series of exposures on color-reversal film at half-stop intervals on either side of your best estimate of the correct exposure. Six or eight exposures will usually be enough. The shutter should be set on 1/25 or 1/30 and left there. Write the f number on a card and include it in the test scene for each exposure. Project the finished slides and choose the best one. Multiply the f number used for that picture by 10 and you have the best guide number for your particular equipment, film, and personal taste. To use it, simply divide the light-to-subject distance into the guide number to get the correct f number.

Q ***Why do I so often louse up color exposures when I seldom miss on black-and-white?***

A This is a little like the difference between shooting sparrows with a rifle and a sawed-off shotgun. Black-and-white films can record a brightness range in the subject of about 130:1. (Brightness range refers to the difference in the intensity of light reflected from the darkest and brightest areas of the scene.) Typically, outdoor subjects in daylight have a brightness range of from 16:1 to 30:1. It's easy to see how the exposure could be off by a couple of stops either way and still fit inside that 130:1 range.

Not so with color film. It can barely record a range of about 16:1, and the colors will hold reasonably true only over a range of about 4:1.

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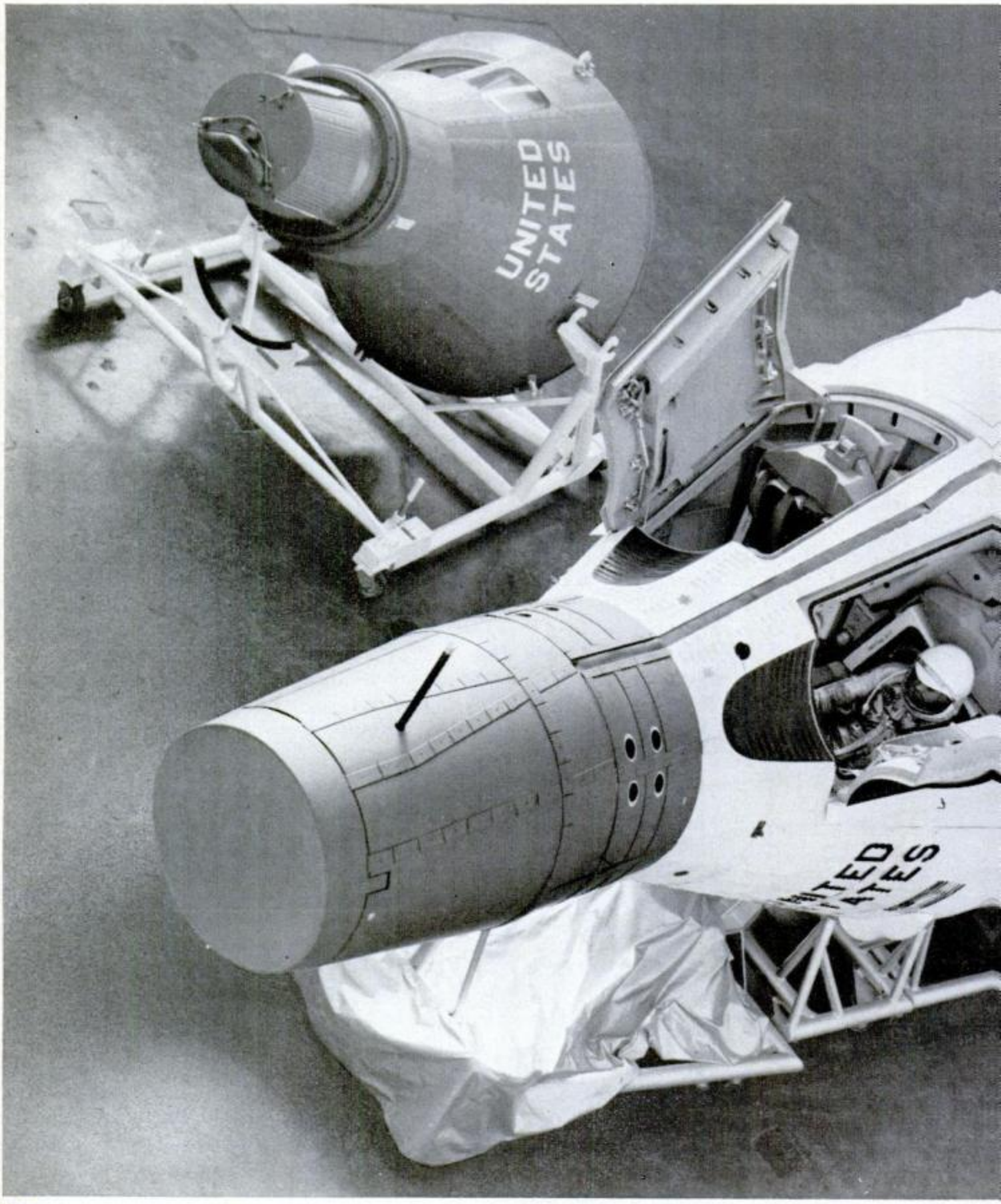
The Gemini mission—what it will be like . . .

Inside Our First Two-Man



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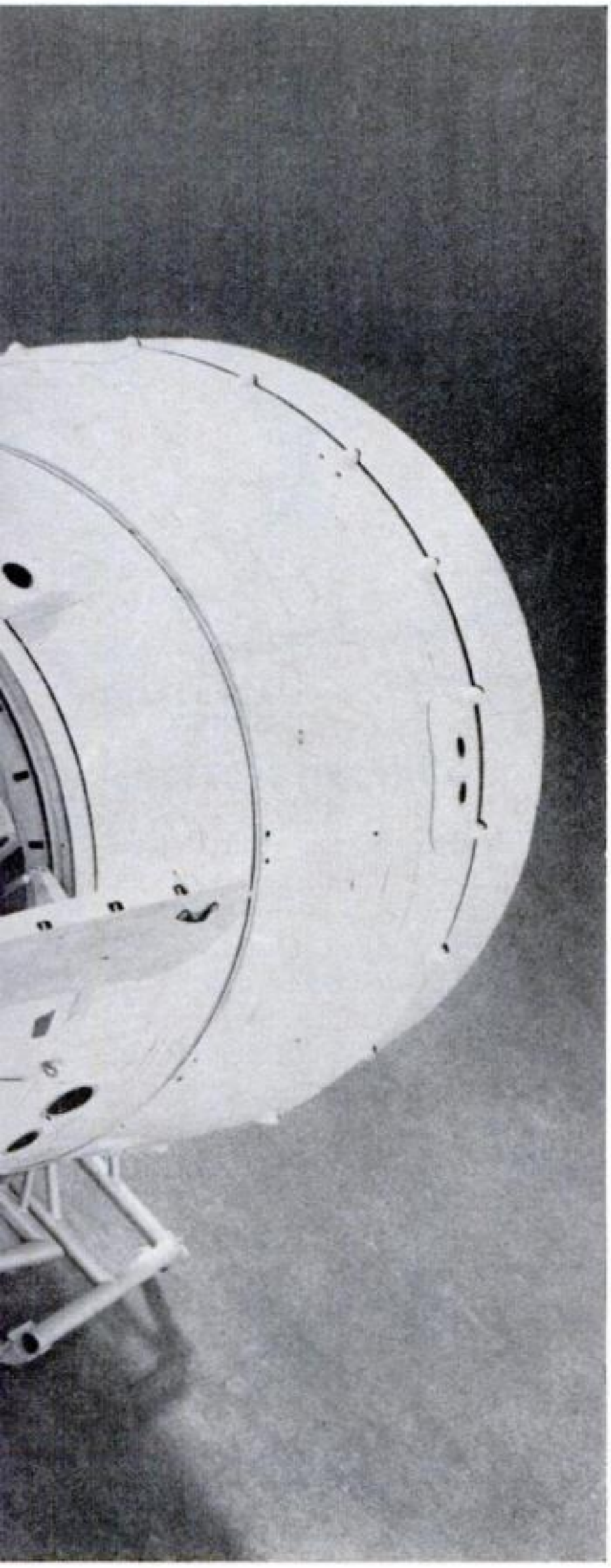
Spacecraft



Getting ready: Scheduled to be first Gemini astronauts, pilot Gus Grissom (foreground) and copilot John W. Young try out their cockpit, which is much roomier than the Mercury capsule.

Not just a scaled-up Mercury capsule, the Gemini spacecraft is a ship for astronauts to fly

By Wesley S. Griswold

WITHIN the next few months, for the first time in our space program, two U.S. astronauts are expected to go into orbit together.

Their vehicle, the Gemini spacecraft, is far more than just a Mercury built for two. Besides being half again as roomy and twice as heavy as Mercury was, it is much more complex and efficient. That is because it will have many intricate tasks to perform before it completes its 12 scheduled missions.

Those missions will include flights lasting as long as two weeks. They will include practice rendezvous with another spacecraft in orbit (an Agena D rocket will play the supporting role). After rendezvous, Gemini will try space-docking, by sliding its nose into a socket in one end of the Agena D. In addition, Gemini's two astronauts will depressurize

CONTINUED

Gemini capsule is shown compared with Mercury at McDonnell Aircraft, St. Louis. Gemini is more sophisticated, weighs about twice as much (7,000 pounds).

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Gemini pilots have to fly the ship—it can't be controlled

their cabin, open its hinged hatches, and take turns floating about on tethers, as future astronauts must be able to do if they are to make repairs en route or build space stations in orbit.

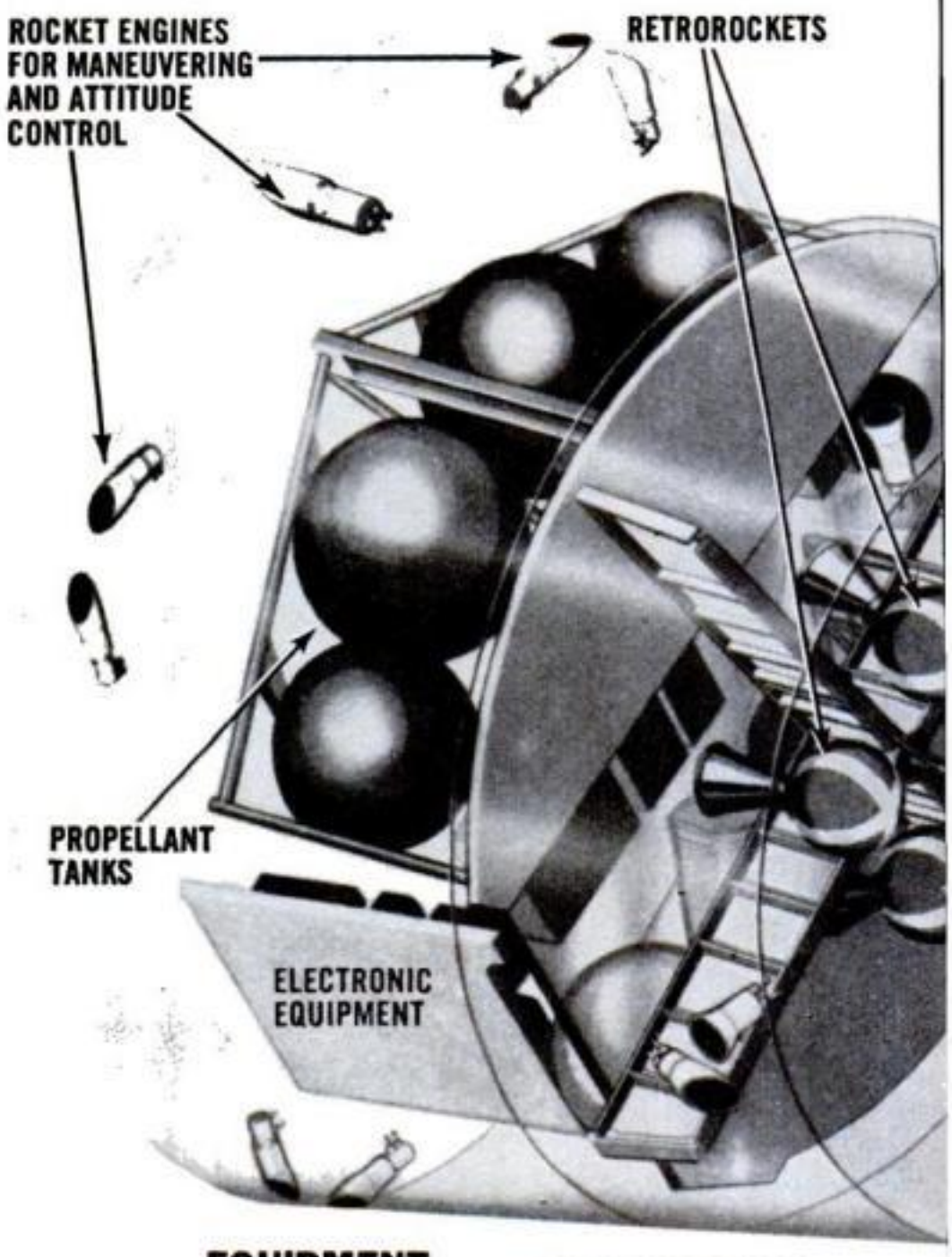
All these demanding and perilous maneuvers must be tried out and perfected before the first manned journey to the moon can be undertaken with confidence.

Gemini's first flight. The more dramatic events will not take place on the first flight. It will be simply a three-orbit journey, lasting about four hours and a half. But in that brief time, Astronauts Virgil I. (Gus) Grissom and John W. Young will use as much as possible of the complicated equipment.

Mercury, in which all essential systems shared the cabin with its sole occupant, was as uncomfortable as a crowded broom closet. On Gemini, everything that can be put out of the astronauts' way has been stowed elsewhere. This was achieved partly by packaging the systems, partly by housing them in the outer section of a doubly constructed re-entry module, and partly by locating them in the adapter section, at the base of the spacecraft.

The crew's pressurized cabin forms the core of the re-entry module. The space between it and the outer shell is filled with instrument packages, electronics gear, and landing gear. This arrangement provides greater protection from micrometeorite damage, as well as greater comfort, than Mercury afforded. Retrorockets, fuel for positioning thrusters, batteries, and the main oxygen supply occupy the adapter section, shed before Gemini returns to the earth's atmosphere.

Mercury's capsule was launched with an escape tower attached, which would have rocketed the entire module out of harm's way if the launching rocket had misfired. Gemini provides its pilot-commander with gauges that tell him precisely how its Titan II booster is behaving. If he reads trouble on the dials, he'll pull a ring beside one knee and catapult both himself and his copilot



out of the module in rocket-fired ejection seats. There's a ring at each seat, and pulling either one ejects both seats. This could be done, if necessary, during re-entry as well as during launch.

Mercury had a small reaction-control system that let its astronaut change the attitude of his craft in space, but not its orbit.

Gemini will be able to move forward and backward in any direction, up and down, and sideways. Thrust for these moves will come from a range of impulses, provided by a hypergolic mix of monomethyl hydrazine and nitrogen tetroxide.

Despite its maneuverability, piloting Gemini will not be much like driving a car. When it changes speed, it also changes the shape of its orbit, and thus its altitude.

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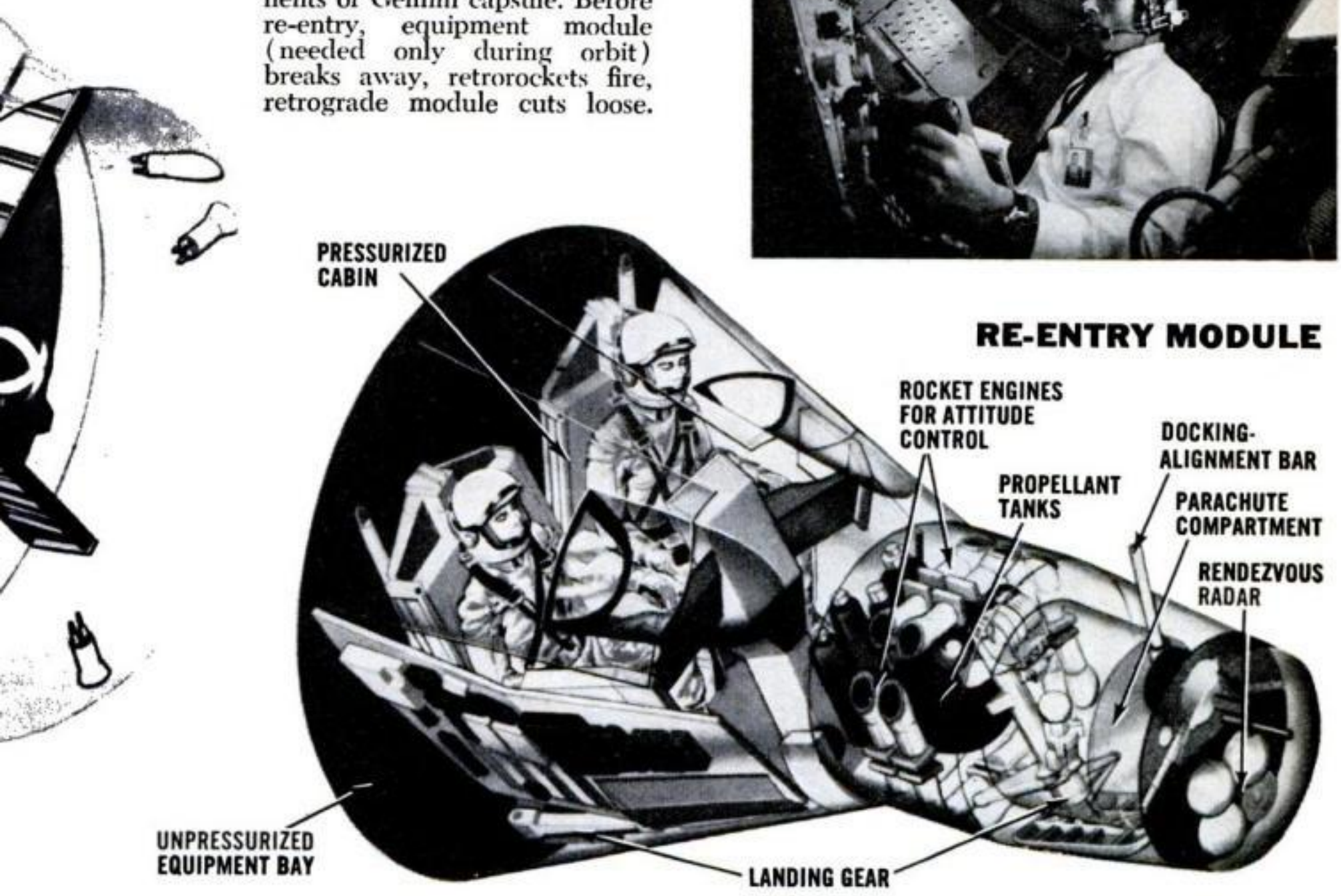
Astronaut Young tries out left-hand attitude-control stick in one of many flight simulations.

Cutaway shows major components of Gemini capsule. Before re-entry, equipment module (needed only during orbit) breaks away, retrorockets fire, retrograde module cuts loose.



Whereas Mercury could be under completely automatic control, either from the ground or from on-board gyros, Gemini is almost entirely under control of the men aboard. It cannot be commanded from the ground. The pilot—or, if he's incapacitated, the copilot—must initiate an emergency exit, if needed, and also must trigger the re-entry system.

Docking. Gemini has a radar, with a 250-mile range; an inertial-guidance platform; and a manual-feed electronic computer, weighing only 57.6 pounds and taking up one cubic foot. Mercury had none of these, and had no need for them. They are essential, however, to Gemini's forthcoming tasks of meeting another spacecraft in orbit and docking with it.

This delicate and difficult job of closing on another vehicle in space when both are going 18,000 m.p.h. can be done automatically if the Gemini pilot chooses, or semiautomatically, or under the pilot's own control.

He needs to know the speed, distance, and direction that will take him to his target. Once the Gemini spacecraft is within 250 miles of the Agena D, its inertial-guidance platform and computer can get this essential information from the radar and guide the craft toward its target without help from the pilot. But if he prefers, the computer will provide him with a readout of the necessary data and he can act on it himself. In the last few feet before docking, the pilot will probably rely wholly on his own vision, judgment, and manual control.

Docking will involve a speed differential of only about 1½ m.p.h. between

[*Continued on page 201*]

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New Ideas from the Inventors

Nail-on scaffold knocks down. You could keep a scaffold handy for shingle repairs and similar occasional jobs with this recently patented support. Sockets welded on an angle-iron support would grip pipes with clamps on their ends. You'd nail the angle-iron supports to the wall, attach the pipes, make up the rest of the rig from two-by-fours and planks.

Cigarette douses itself. A slidable aluminum-foil cigarette band might prevent some fires caused by neglected or discarded cigarettes. The cigarette would put itself out when it burned down to the band. Or it could be extinguished—for later smoking or because there's no ashtray handy—by moving the band upward.

Friction stop holds door. You could leave a door ajar safely by slipping the yoke of this door brace under the knob. A wedge-shaped foot would stop the door at a safe, preset distance. The harder the door was forced from the outside, the firmer it would grip. Unlike some conventional chains, it couldn't be dislodged by a wire.

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Trim guide adapts razor. You could give your kids—or yourself—professional-looking haircuts with your electric shaver and this guide. Contoured to follow the curve of your head, neck, and ears, the rails of the guide would adjust to track any shaver and to set the cutter distance so you'd get a close but tapered trim.

Door scraper keeps car clean. Mounted inside the lower edge of your car door, this U-shaped metal—or plastic—strip would hinge down from its screwed-on supports to let car occupants scrape mud or snow from their shoes before settling in. The scraper would fold up to fit the normally tight space between the door and seat.

Extra bed extends truck. A pickup or other small truck might handle longer or heavier loads with this extra platform and wheeled axle. Designed to fit the truck's own bed, it would lock in securely to distribute weight over four wheels. The extension bed would store away when the truck was to be used for normal loads.

The following patents have been issued on these inventions. **Nail-on scaffold**—*No. 3,120,878 to P. E. Neeley, Gering, Neb.;* **Cigarette band**—*No. 3,091,243 to F. C. Guida, Pittsfield, Mass.;* **Door stop**—*No. 3,124,382 to R. S. Strother, Vallejo, Calif.;* **Haircut guide**—*No. 3,055,376 to E. H. Walls, Davenport, Iowa;* **Mud scraper**—*No. 3,097,388 to S. J. Gresko, Fort Wayne, Ind.;* **Truck extender**—*No. 3,129,958 to L. S. Mortensen, Helper, Utah.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 25 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

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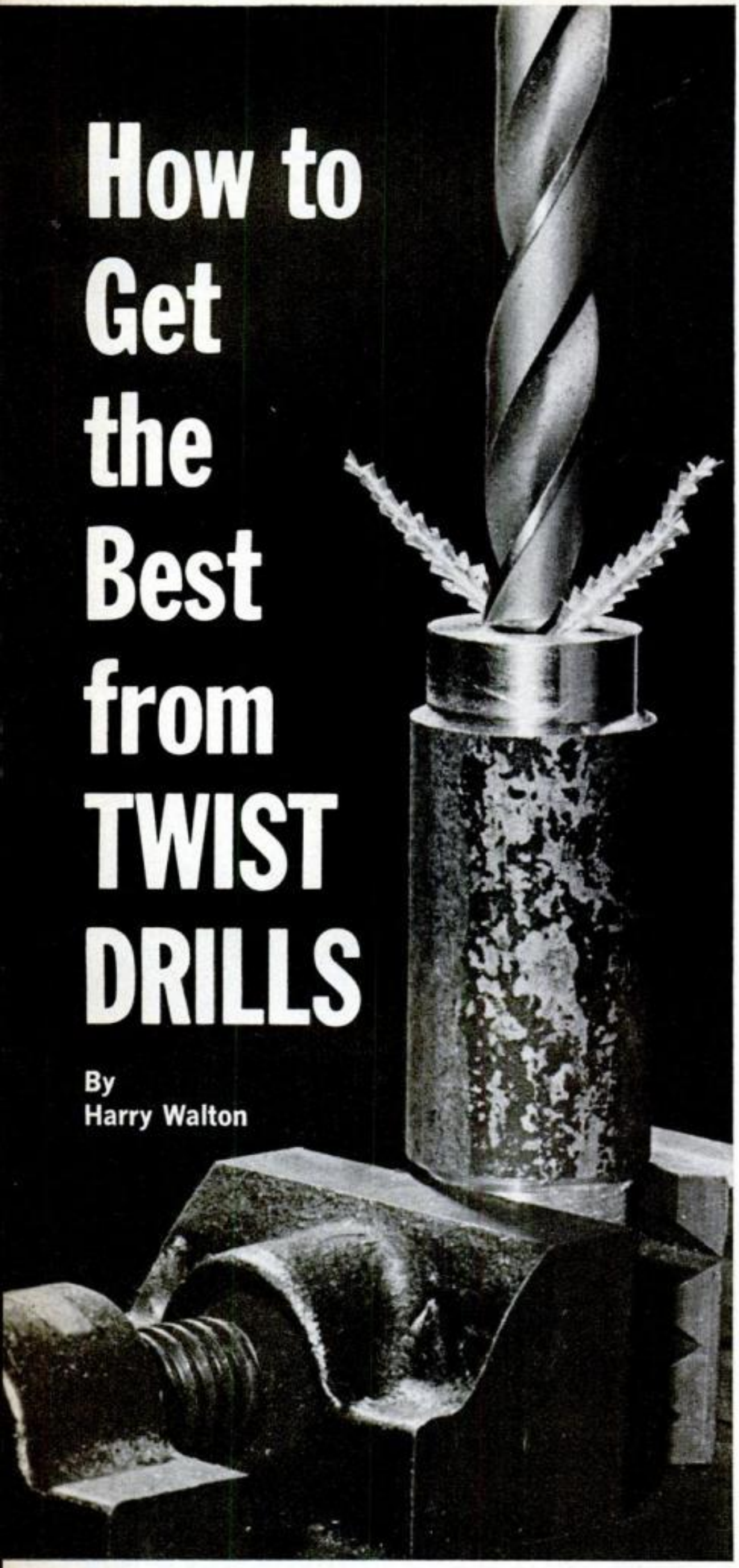
How to Get the Best from TWIST DRILLS

By Harry Walton



Two perfect chip curls of equal length are a sign this drill is cutting correctly. Ragged, unequal chips spell trouble.

Spark test on a grinding wheel tells if a drill is high-speed or carbon steel. High-speed bit above gives off relatively few sparks.

DO YOU waste money paying $5 for a set of high-speed-steel drills when you could get carbon-steel drills for $3? Are high-speed-steel drills really better? Are drilling speeds important? Should you always use a cutting fluid?

The answers depend on *what* you're drilling. Twist drills—the most common shop drills—tend to get used for anything and everything, often wrongly. Many times it's not the drill itself but the way it's used that makes the difference between a good job and a botched one. Know the basic facts about twist drills and you can do better work and get more for your drill dollar.

High-speed or carbon steel? The only real difference between

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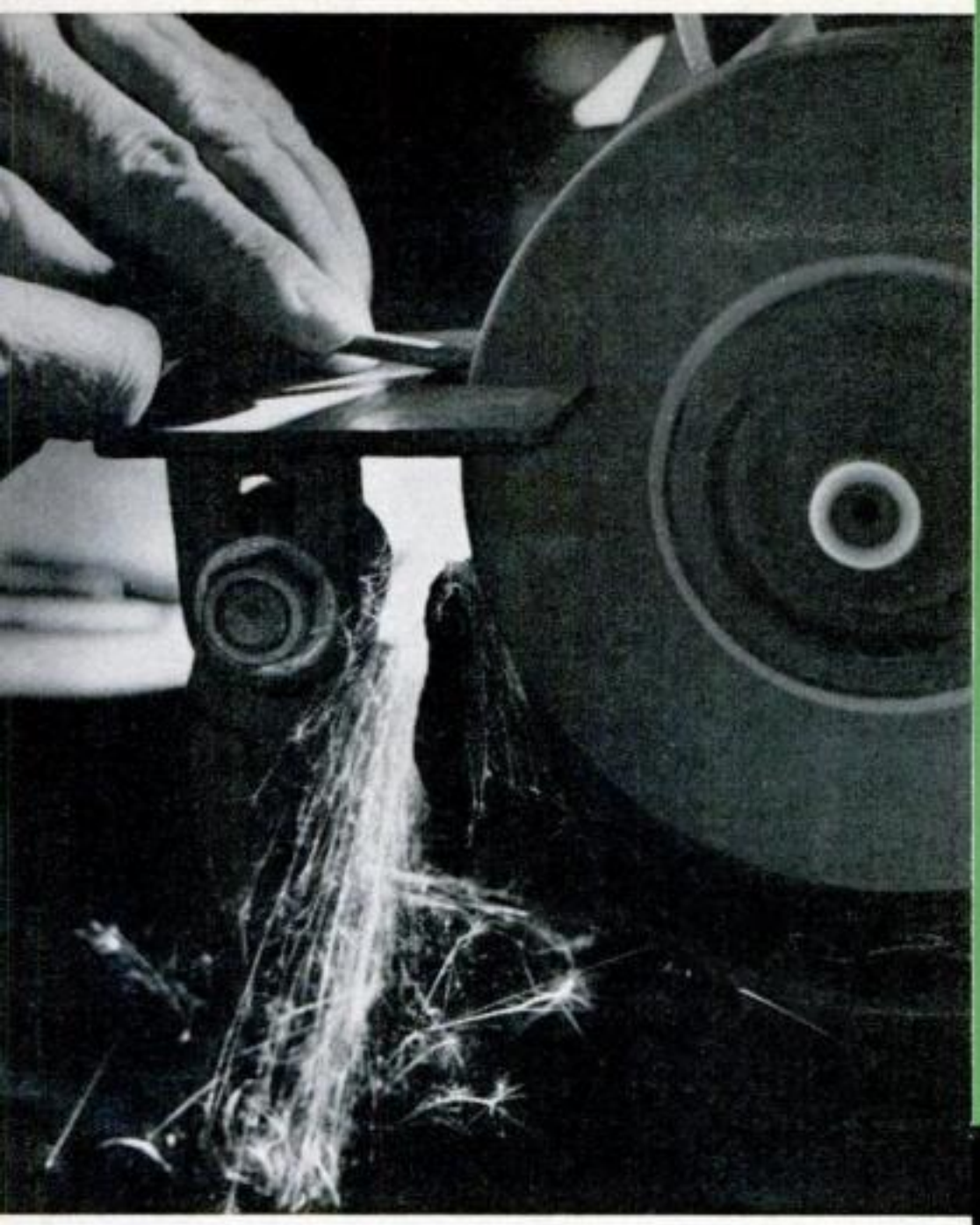
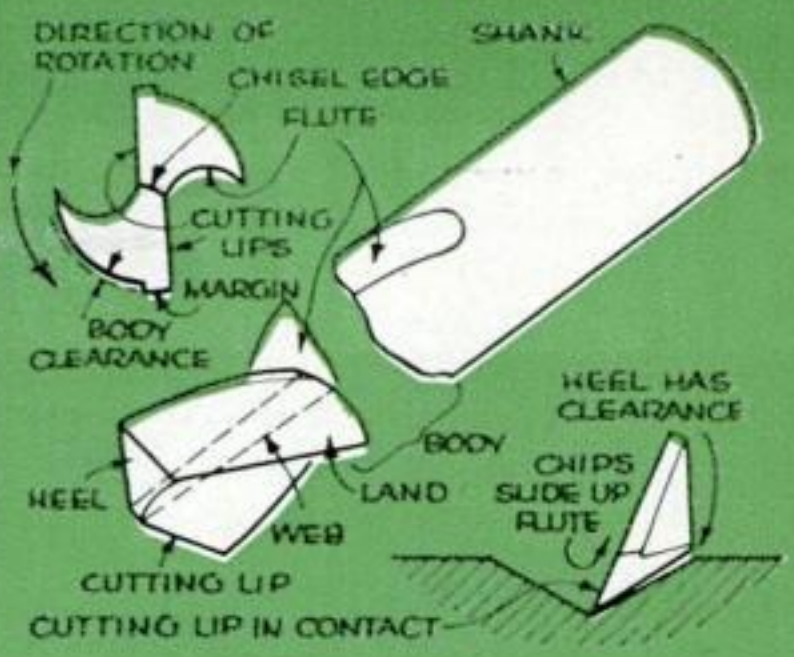


Carbon-steel bit gives off generous shower of sparks when lightly ground on shank. Sparks are white; those from bits of high-speed steel shade from orange or red to straw color.

ANATOMY OF A TWIST DRILL



Chisel edge at end of the web centers the drill, but the real work is done by the two cutting lips. Heel surface behind each lip must clear bottom of hole to prevent friction and let edge cut. Chips escape along the two deep grooves or flutes. The lands—solid areas between the flutes—are ground slightly smaller than drill's working diameter except for a narrow margin on the lip side of each land. The web gets progressively thicker from the tip to the shank end.

these two is in their ability to withstand heat. But it's an important difference. A drill bit generates heat. The bigger its size or the higher its speed or the tougher the material, the more heat it generates. When this heat gets too high, the drill literally softens and loses its cutting edge.

Carbon-steel drills lose their temper at 350 to 400 degrees. High-speed drills stay hard up to about 1,000 degrees. Carbon-steel drills are perfectly good *when used within their safe heat range.* In fact, a properly used carbon-steel drill will cut just about as well and last just about as long as its high-speed equivalent.

If you work mainly in wood or have a variable-speed drill or a drill press that can be slowed down, carbon drills are a good buy. But if you do a lot of metal drilling, particularly with a fixed-speed drill, then high-speed bits are a must. As you can see in the drill-speed chart (upper right), the 1,800 to 2,200 r.p.m. of

CONTINUED

SAFE DRILLING SPEEDS FOR MILD STEEL (r.p.m.)

DRILL SIZE (inches)	INDUSTRIAL USE (with machine feed and copious lubrication)		HOME-SHOP USE (with hand feed and intermittent or no lubrication)	
	CARBON	HIGH-SPEED	CARBON	HIGH-SPEED
1/16	1,830	6,110	920	3,060
3/32	1,220	4,075	610	2,050
1/8	920	3,060	460	1,530
3/16	610	2,040	310	1,020
1/4	460	1,530	230	760
5/16	370	1,220	180	610
3/8	310	1,020	150	510
1/2	230	764	115	380

WHICH CUTTING FLUID TO USE ON WHAT

MATERIAL	TYPE OF LUBRICANT
ALUMINUM AND ITS ALLOYS	Kerosene, kerosene and lard oil, or soluble oil
BRASS	Kerosene and lard oil, soluble oil, or none
BRONZE	Soluble oil, lard oil, or none
COPPER	Mineral-lard oil and kerosene, soluble oil, or none
MONEL METAL	Mineral-lard oil or soluble oil
MILD STEEL	Mineral-lard oil or soluble oil
TOOL STEEL OR FORGINGS	Sulfurized oil, mineral-lard oil, or kerosene
MALLEABLE IRON	Soluble oil or none
STAINLESS STEEL	Soluble oil or sulfurized oil
TITANIUM ALLOYS	Soluble oil or sulfurized oil
WROUGHT IRON	Soluble oil or sulfurized oil
MANGANESE STEEL	None
PLASTICS, FIBER, ASBESTOS, WOOD	None

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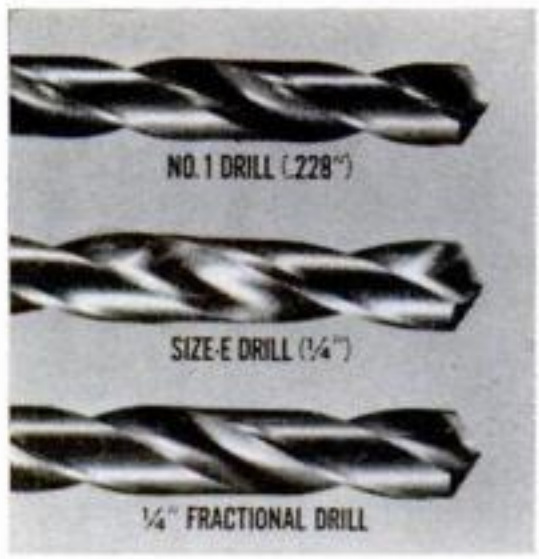
a typical fixed-speed portable drill is too high for even the smallest carbon drill listed.

In wood, you can use carbon bits in a fixed-speed drill—but only in wood. Even where you can use carbon bits at low speeds, high-speed bits have an advantage: You can run them faster and thus get the job done more quickly.

Keep the drill cutting. A drill that isn't advancing in its hole is wearing, dulling, and generating excess heat, which in turn speeds up the dulling process. This leads to one of the most important rules in good drilling technique: Keep the drill cutting at all times—even if you have to "lean" on it.



Look-alikes represent three different methods of drill identification. Except for size E, lettered and numbered drills do not come out to exact fractional-inch sizes.

Why drill speeds are important. The important thing about drill speed is the actual surface speed of the bit at its rim—the point where friction builds up heat. As a drill increases in diameter, its rim speed goes up astronomically even though its chuck speed stays the same. In other words, the bigger the drill, the slower you must run it.

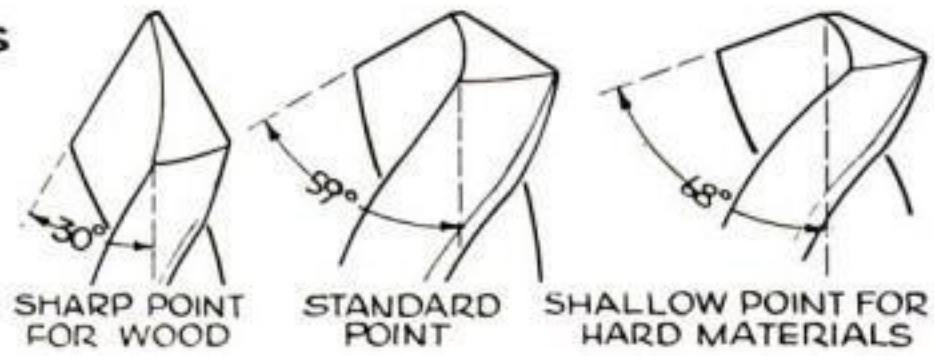
The drill-speed chart is based on mild steel because this is the metal you're likely to be drilling for the average shop project and for around-the-house repairs. The industrial speeds given are for *maximum cutting efficiency* without regard to drill life. For home-shop use, these speeds have been reduced to give longer drill life.

Materials that are softer than mild steel, such as brass, bronze, aluminum and zinc alloys, and some plastics, can be drilled at

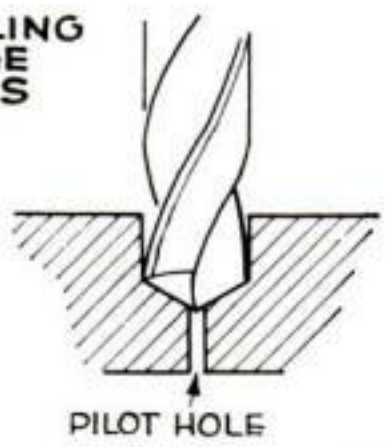
[*Continued on page 210*]

THE THREE TYPES OF DRILL POINTS

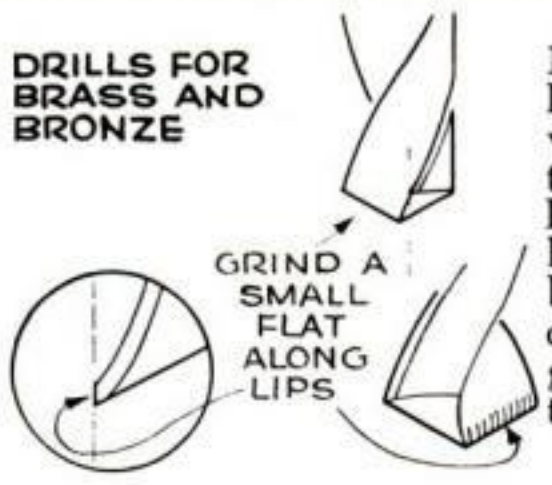
Extra-sharp point (near right) is best for soft materials like wood, fiber, aluminum. Standard point (center) is medium for average metal drilling. Extra-shallow point (far right) handles hard steel alloys.



DRILLING LARGE HOLES



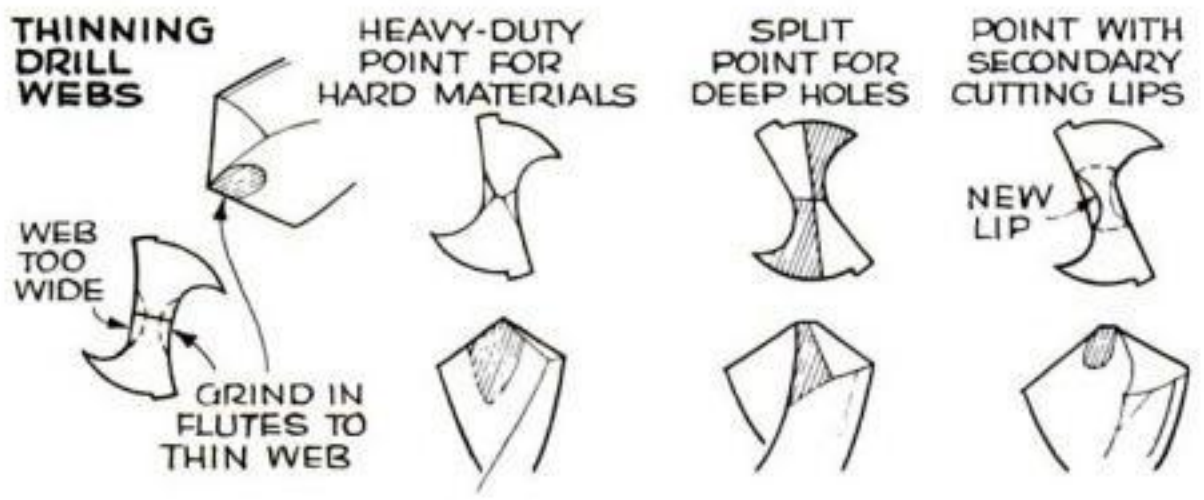
DRILLS FOR BRASS AND BRONZE



In using big bits, drill a pilot hole first the size of the bit's web (far left). This guides the bit, lets it cut faster with less feed pressure. To avoid hogging in on brass and bronze, alter positive rake on cutting lips to zero rake by grinding a narrow flat along them, as at near left.

Repeated sharpening shortens a drill, and the web thickens. This slows cutting action, requires excessive feed pressure. Keep web thin by grinding in flutes (right). For hard materials, deep holes, web thinning can be combined with notching, as shown.

THINNING DRILL WEBS


HEAVY-DUTY POINT FOR HARD MATERIALS
SPLIT POINT FOR DEEP HOLES
POINT WITH SECONDARY CUTTING LIPS
WEB TOO WIDE
GRIND IN FLUTES TO THIN WEB
NEW LIP

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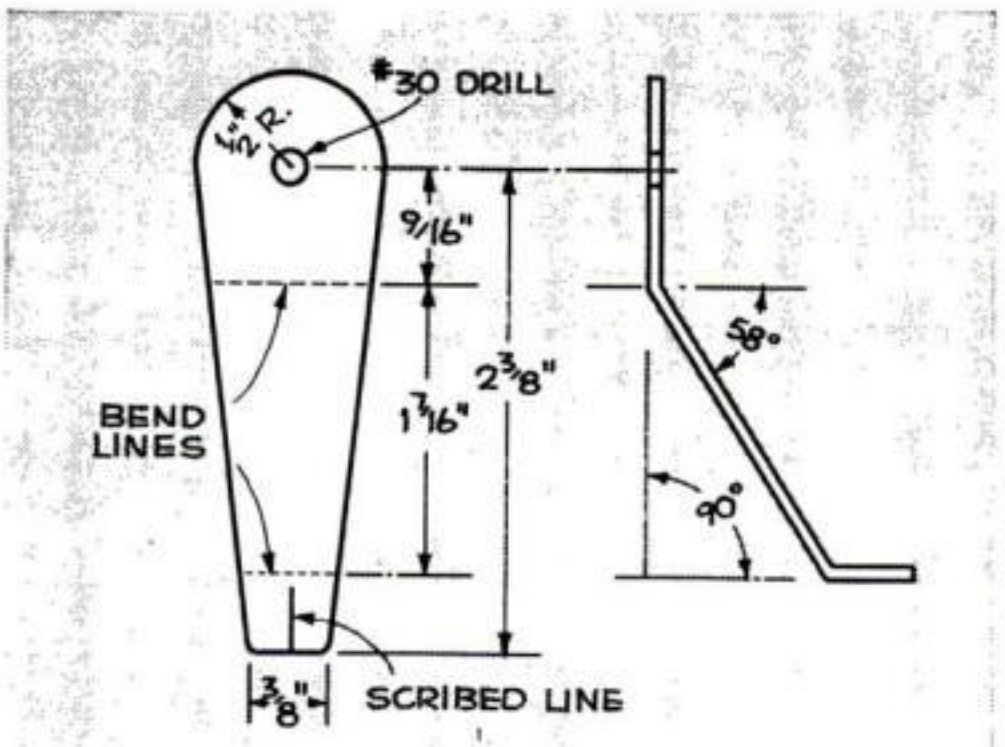
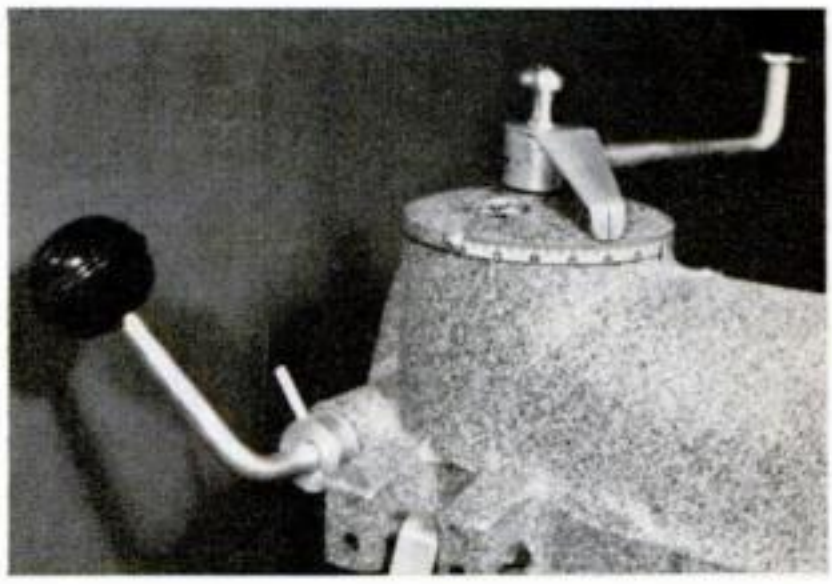
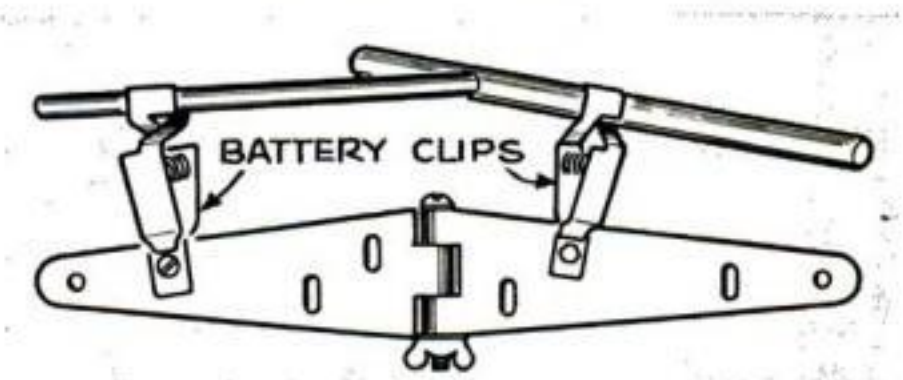


Precision depth-of-cut indicator

Here's an easy way to turn a radial saw's depth-of-cut indicator into a precise aid in your shopwork. You attach the indicator, cut and bent as shown in the diagram above, to the saw handle with a thumbscrew or wingnut. On a saw that has an elevating screw of 8 threads per inch, each full 360-degree turn will raise the saw ⅛". Five degrees will move the blade .0017". *—Richard Decker, Huntington, N. Y.*

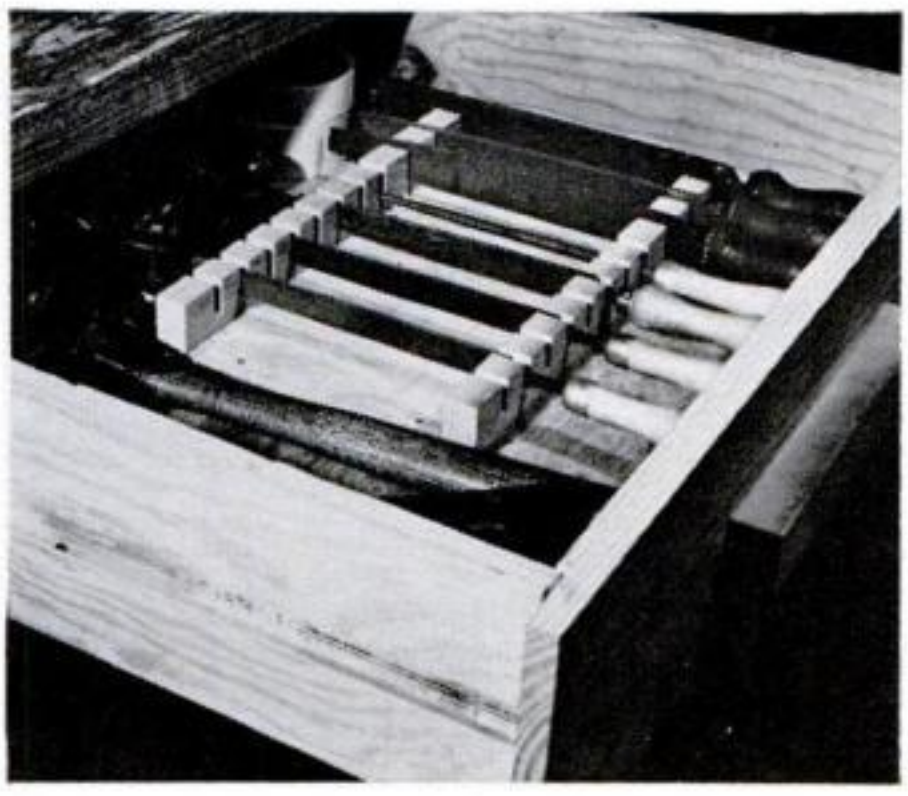


▶▶▶Children will be heard before they are hurt if you rig an "alarm" on all medicine bottles, knife drawers, electric plugs within their reach. The best way I know of doing this is to tie small Christmas bells on each danger item. They tinkle to alert you when a child touches the object.*—A. Weber, Edmonton, Alberta.*



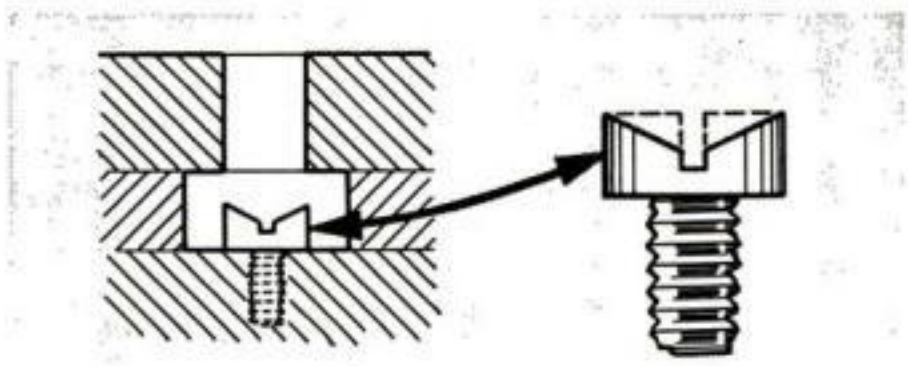
Hinge is clip jig for angle welding

Planning some odd-angle welding? Here's a handy jig you can make from any strap hinge by removing the pin and replacing it with a wingnut and bolt as shown above. Fasten the clips to the hinge where they will be best suited for the work. For straight work, hold the jig in a vise or clamp.*—Peter Legon, Malden, Mass.*



Protect your files with a slotted holder

This holder built into your workbench drawer keeps your collection of files conveniently at hand. It also will keep files from rolling around, causing damage to or being damaged by other tools. You make it by slotting two pieces of scrap wood and screwing them to the bottom of the drawer. *—Marshall Lincoln, Indianapolis.*



Make concealed screws easier to turn

You can end groping with a screwdriver for hard-to-get-at adjustment screws with the simple operation above. File the flat head down at an angle, which will allow you to slide the screwdriver into the slot by feel.*—Joseph Braunstein, Forest Hills, N.Y.*

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Is there a modernization program in prospect for the cooking department of your home?

Job-Proven Ideas for Better Kitchen Cabinets

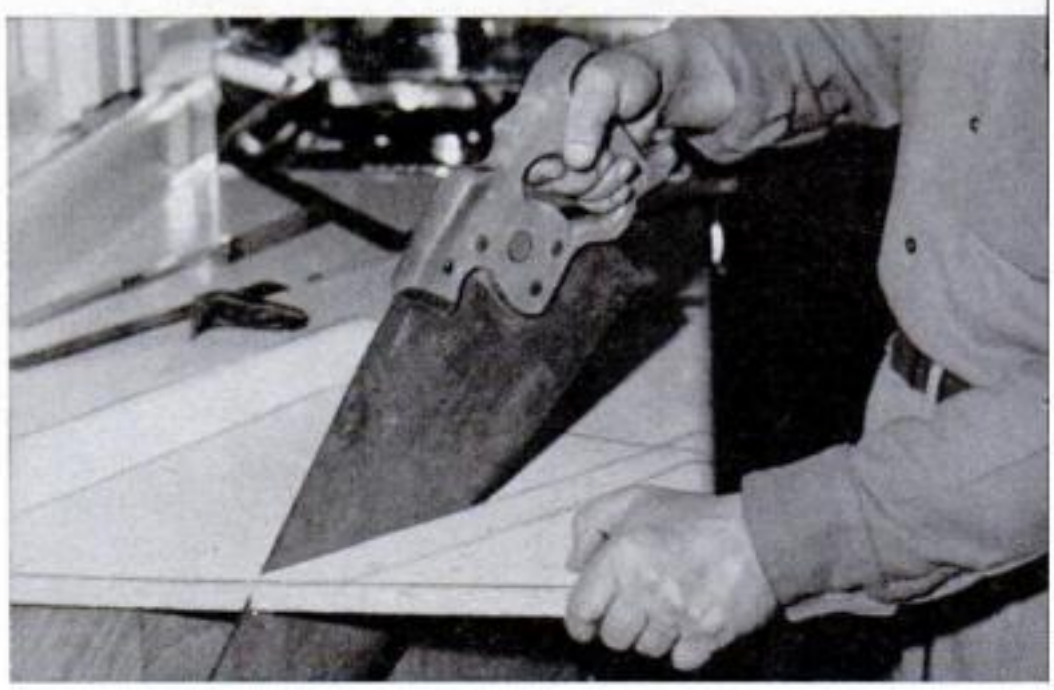
By Ralph S. Wilkes

What to do with a small space

When you build wall cabinets around existing appliances, space sometimes is not fully utilized. Here's an example—a narrow area under cabinets placed above a refrigerator. A compartment with a vertical partition for cookbooks makes use of it. A spice rack also might have been put there.

You can reach a can at the back

That's the advantage you gain by installing shelves that slide out. Hardware stores stock smooth-action slides to make the job easy. If you wish, you can cover the ¾" plywood shelves with counter topping. Glue and nail lip strips around all the shelf edges to keep stored items from sliding off. The strips can go against the edges (also hiding the plywood laminations) or on the upper surface of the shelf.



How to cut a corner in cabinet building

In planning a kitchen layout, if a sharp cabinet corner will obstruct passage or be a bumping hazard, plan to cut it off. You can do this even if you use a molded plastic-laminate counter.

Build the cabinet itself with two 135-degree corners instead of one square (90-degree) corner. You achieve such corners by making four 22½-degree cuts (see sketch) on the edges of the vertical panels. The job

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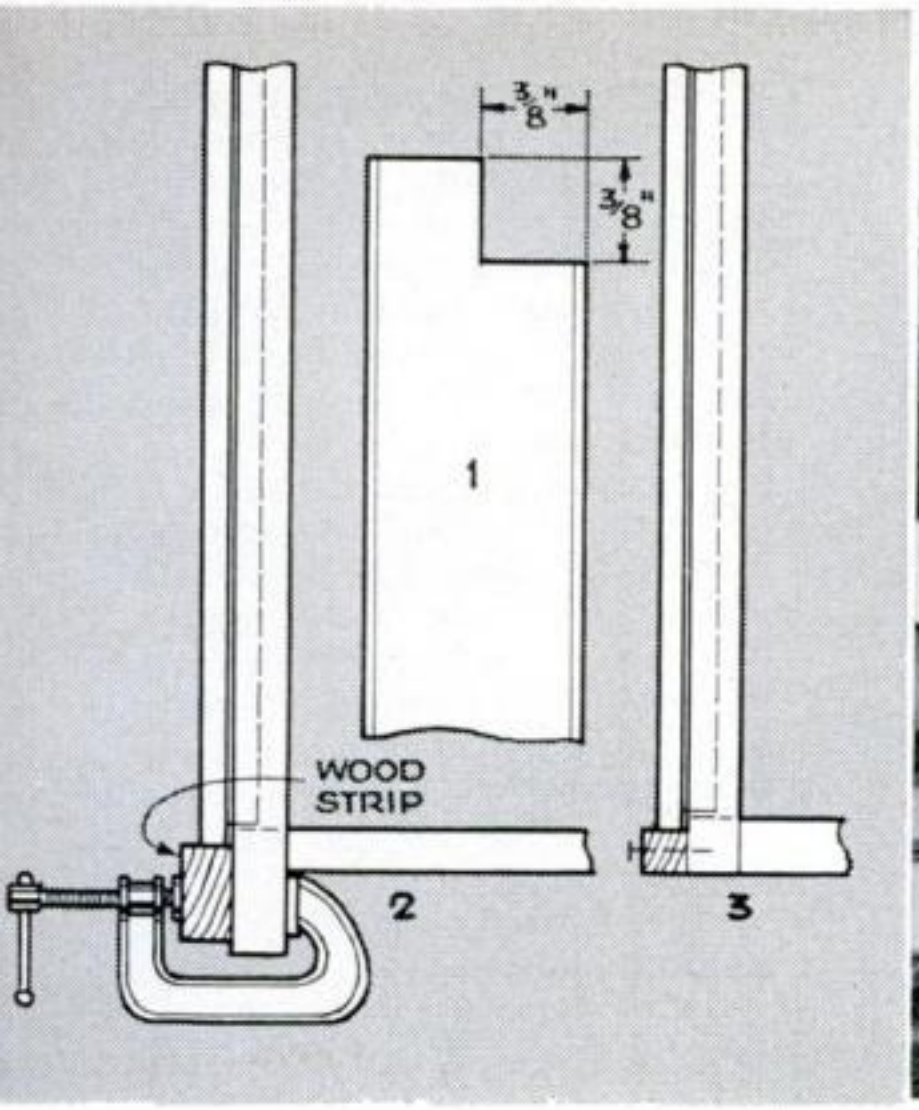
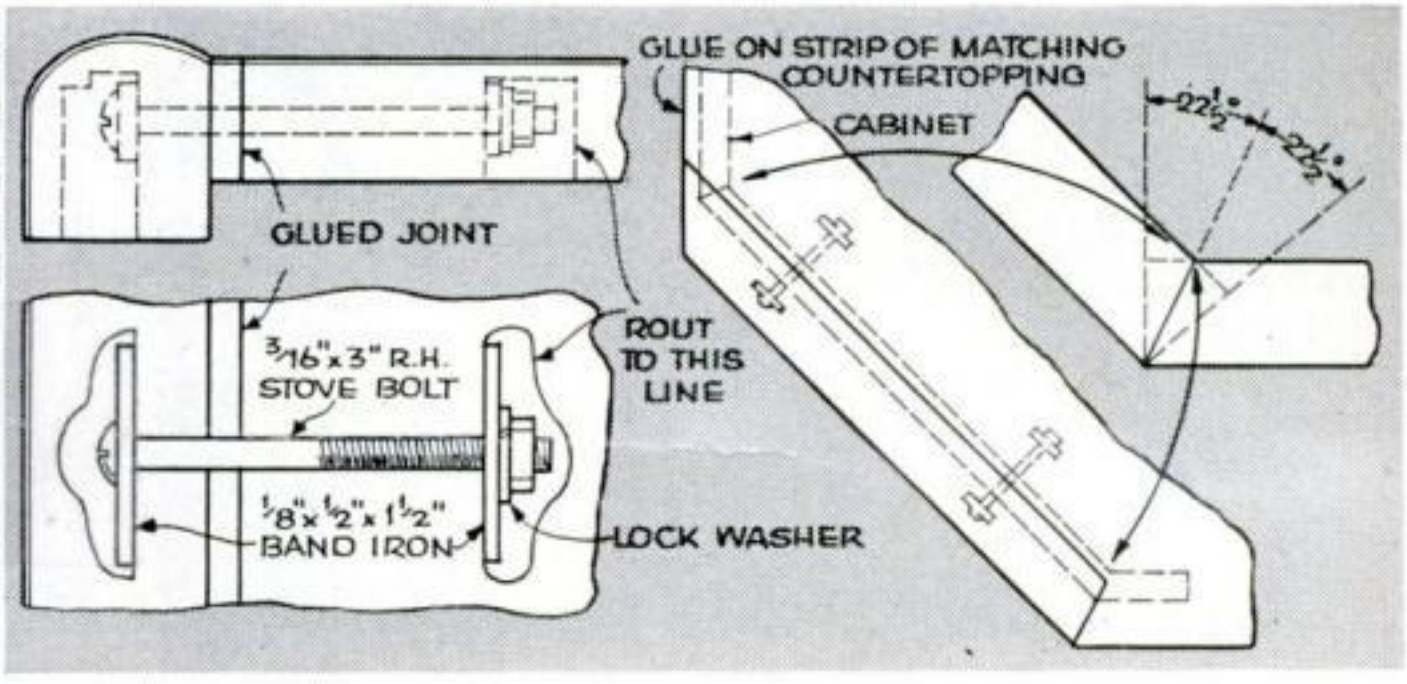


Aligning cabinet doors for mounting

Semiconcealed hinges for lipped doors usually require a ⅜"-by-⅜" rabbet on all four edges (Fig. 1). Door measurements should allow a clearance of 1/16" to ⅛" on all sides of the opening.

After attaching the hinges to a door, set it in the opening. Then place a straight piece of wood under it and raise the strip and door an amount equal to the clearance you are allowing. Clamp it there (Fig. 2) and screw the hinges to the cabinet frame. If there's no lip below the cabinet for clamping, tack the strip in place (Fig. 3).

This procedure will assure that top and bottom edges of doors in adjoining cabinets will be perfectly aligned.



to make an obstruction-free walkway

will look best if you cut all three pieces—front, angled face, and end—from one piece of ¾" veneer plywood, carrying the same grain across all three surfaces. If you wish, you can cut a door in the corner panel, or even in the end, for better access to the cabinet interior.

Use a sharp, fine-tooth handsaw to cut off the corner of the counter. For a molded edge strip to go there, ask the supplier to include the pie-shaped scraps of the same material from an inside cut of a 90-degree corner angle. These are usually wasted. Cut the front edge from one of the scraps, cut the ends of the strip at 22½-degree angles, rout out openings as indicated (including an open slot for the head end of the bolt), and clamp the edge by drawing up on the nuts. Glue a strip of matching material to the end.

CONTINUED

Urheberrechtlich geschütztes Material

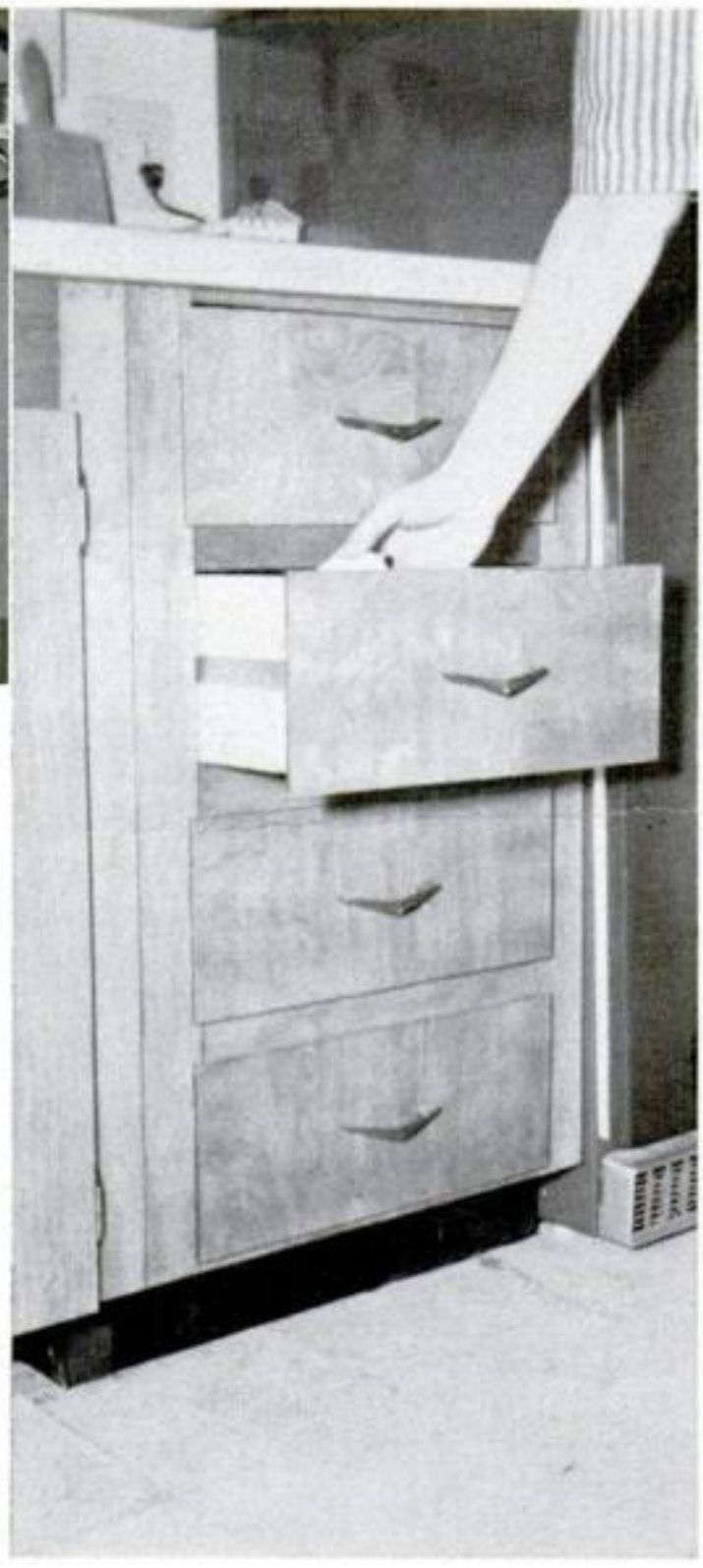
How to make use of all the wall space you've got—near the ceiling, too

Kitchen designers often specify a soffit (merely a boxed-in area) to fill out the space between the tops of wall cabinets and the ceiling, especially when standard-size commercial cabinets are to be installed. This upper 8″ to 12″ of wall space is thus wasted.

You can make good use of it, at least for "dead" storage, by putting shallow cabinets with sliding doors above the regular cabinets. These doors are easy to install if you make them of ¼″ plywood and use aluminum door tracks, available in most hardware stores. The tops of the regular cabinets can serve as the bottoms for the ceiling units in most cases.

You can use the old drawers—with new facings

BEFORE



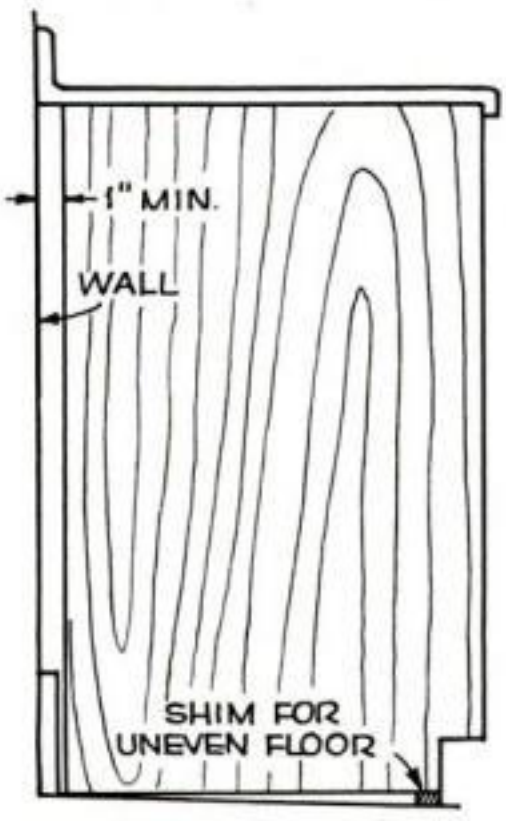
AFTER

The accompanying photos are an example of how it's often possible to use parts of old cabinets in modernizing a kitchen. In this case, the entire drawer section was re-used by replacing the front frame, gluing on new facings, and attaching new pulls. There was no need to make new drawers—a major saving both in time and materials.

How to plumb base cabinets

Don't try to build base cabinets to suit sagged floors and uneven walls. Build them with square corners. If the floor sags away from the wall, shim up the cabinet until the counter is level. You can use a thin strip of wood for the shim. Finish it to match the cabinet or hide it with molding or a flooring kick strip.

Set the cabinet at least an inch away from the wall to permit leveling.



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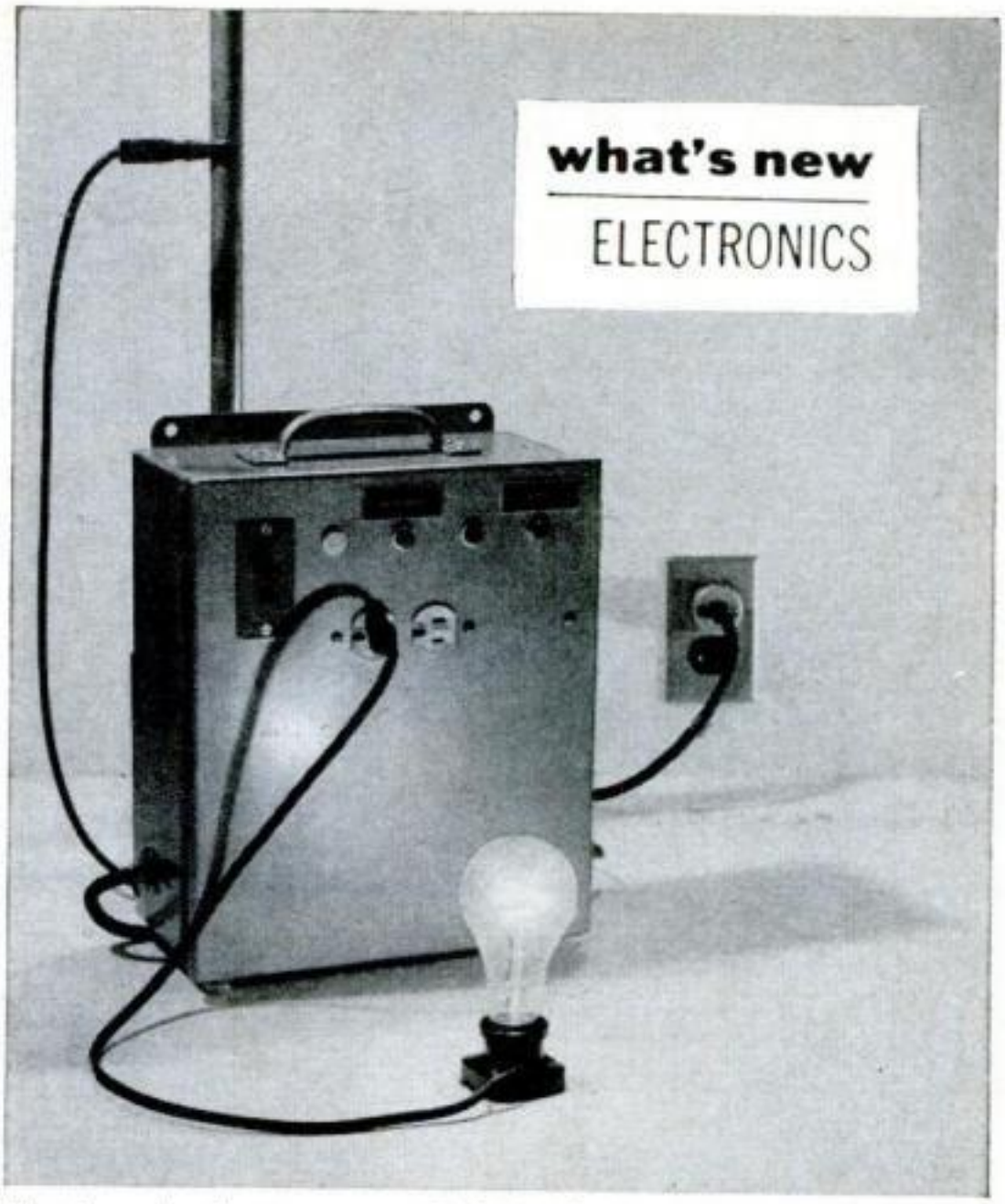
This Shock Preventer Could Save Your Life

It cuts the power before a wiring fault can shock you

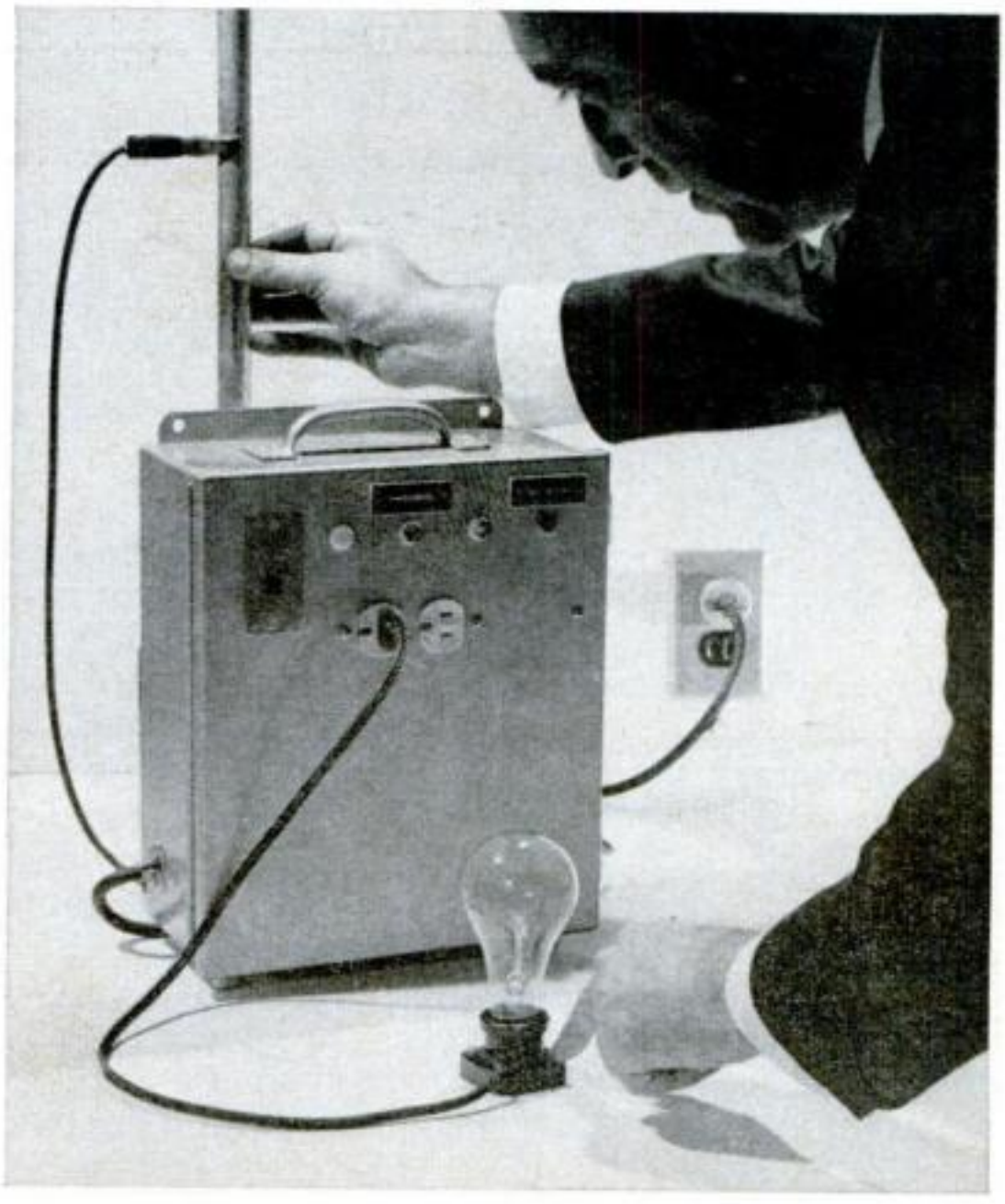
MOST circuit breakers protect house wiring. A new one—the Circuit-tron—protects you. It cuts the power if a portable tool you're using is about to shock you.

Any hand-held power tool—from drill to hedge clipper—can be a shock hazard if an insulation breakdown makes the tool's metal housing electrically hot. If you're holding the tool and accidentally touch an electrical ground—a grounded water pipe or a damp cellar floor, for example—the flowing "leakage" current will shock you.

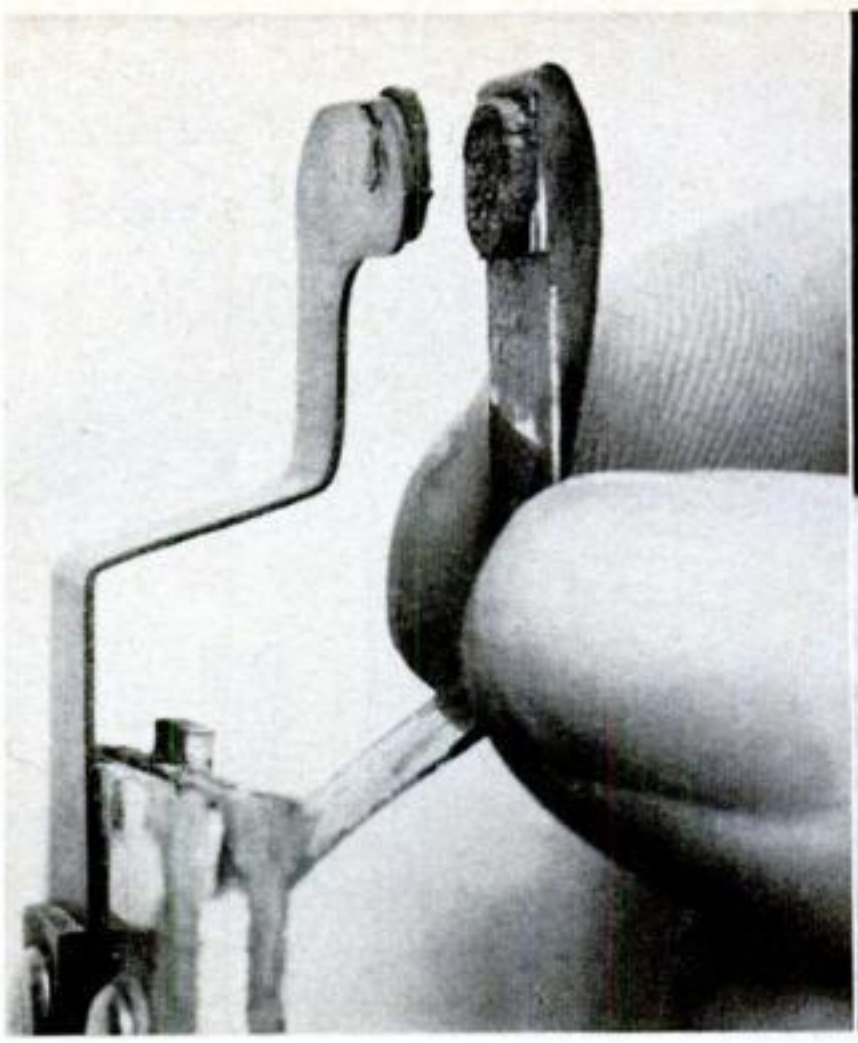
The Circuit-tron is as easy to use as an extension cord: Plug it into a wall socket, attach its ground lead to the nearest electrical ground, and plug the power tool into one of the panel-mounted receptacles. If the device detects dangerous leakage current, it shuts off power to the tool in thousandths of a second. A panel-mounted push-button resets the device. The model shown can handle 120-volt AC loads up to 15 amperes. About $180. Electronic Instruments Corp., Lee, N.H.

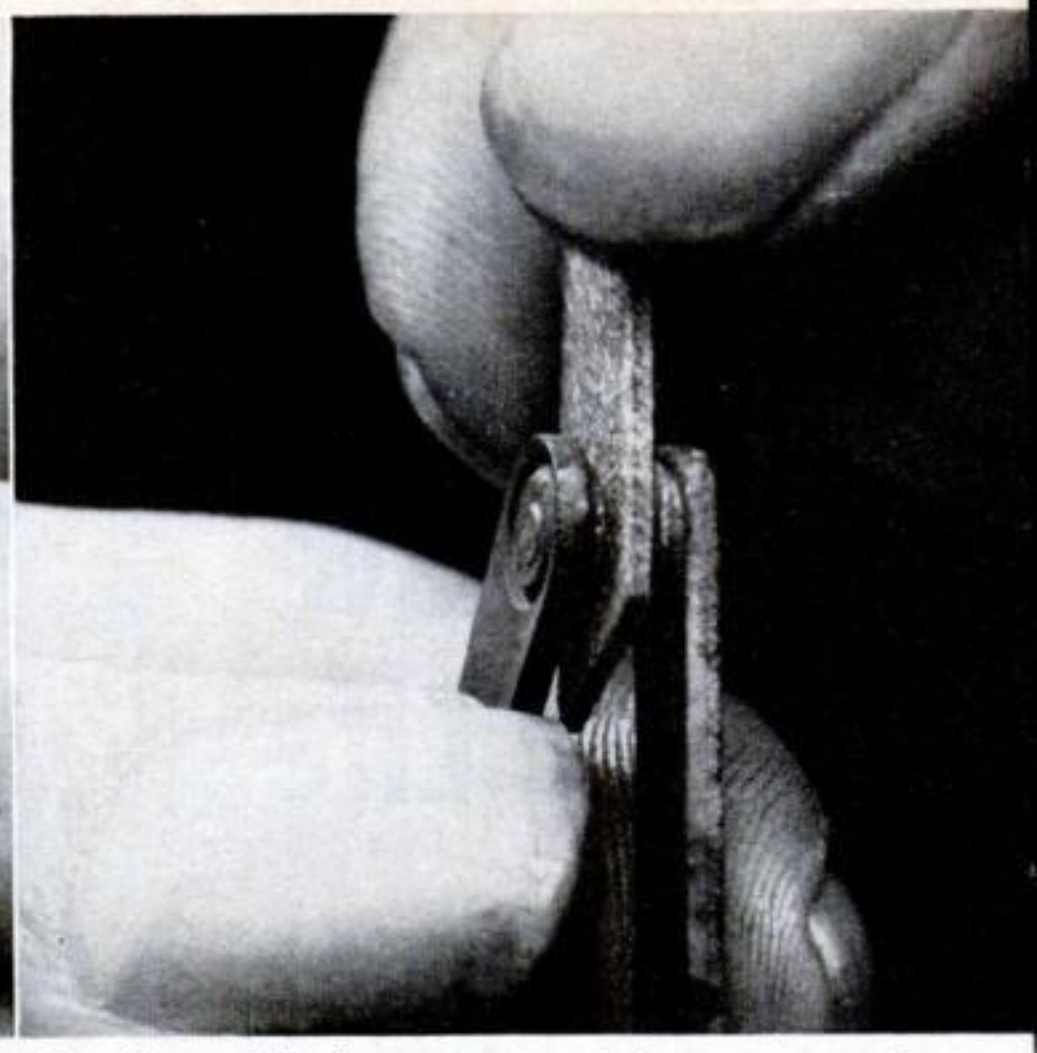


Testing shock stopper with light bulb representing typical load, PS staffer (below) touches simultaneously an exposed wire and a grounded pipe. Circuit-tron instantly cuts power. Model shown is portable; later ones will install in house wiring to guard every wall outlet.



Urheberrechtlich geschütztes Material





Heavily oxidized contact points, as seen at left, can be cleaned with a fold of abrasive paper or a Flexstone (photo above). This will often restore normal operation.

PS HOME REPAIRS

In Appliances, It's the

One of your appliances kaput? Take a look at those vulnerable—but easily fixable—contacts

By John Burroughs

NEXT time your wife moans because a pet piece of household machinery fails, maybe you can fix it yourself. Look first at the electrical contacts, especially the make-and-break contact points that automatically control its power circuit.

Burned contacts aren't *always* at fault in such failures, but experience has shown that they're the weakest link in any electromechanical system. They frequently burn or weld together long before other electrical or mechanical parts give out.

That's particularly true of appliances drawing heavy current. Points carrying low amperage last indefinitely. A good example is the contacts in the room thermostat controlling the stack relay that starts your heating plant. But when a pair of contacts carries a 115-volt current as high as one amp, they arc each time they operate. When the current draw is even higher (for an appliance motor, about five amps; an electric frying pan, about ten), the contacts governing the circuit will flash at each make and break like a midget arc welder. Each arc melts and oxidizes some contact metal.

What makes 'em go? The life of contact points is determined largely by the frequency with which they operate, and the rate at which the metal they're made of oxidizes. Copper, silver, and tungsten are the metals generally used.

Copper and copper-alloy contacts, widely used because they're cheap, oxidize quite rapidly. Copper oxide, and the copper sulfide that often forms from sulfur in the air, produce a very high electrical resistance. Arcing occurs, and the points start to go. Heavy oxidation can completely insulate copper contacts in 115-volt circuits.

Silver and silver-alloy contacts cost some 20 times as much as copper points, but are

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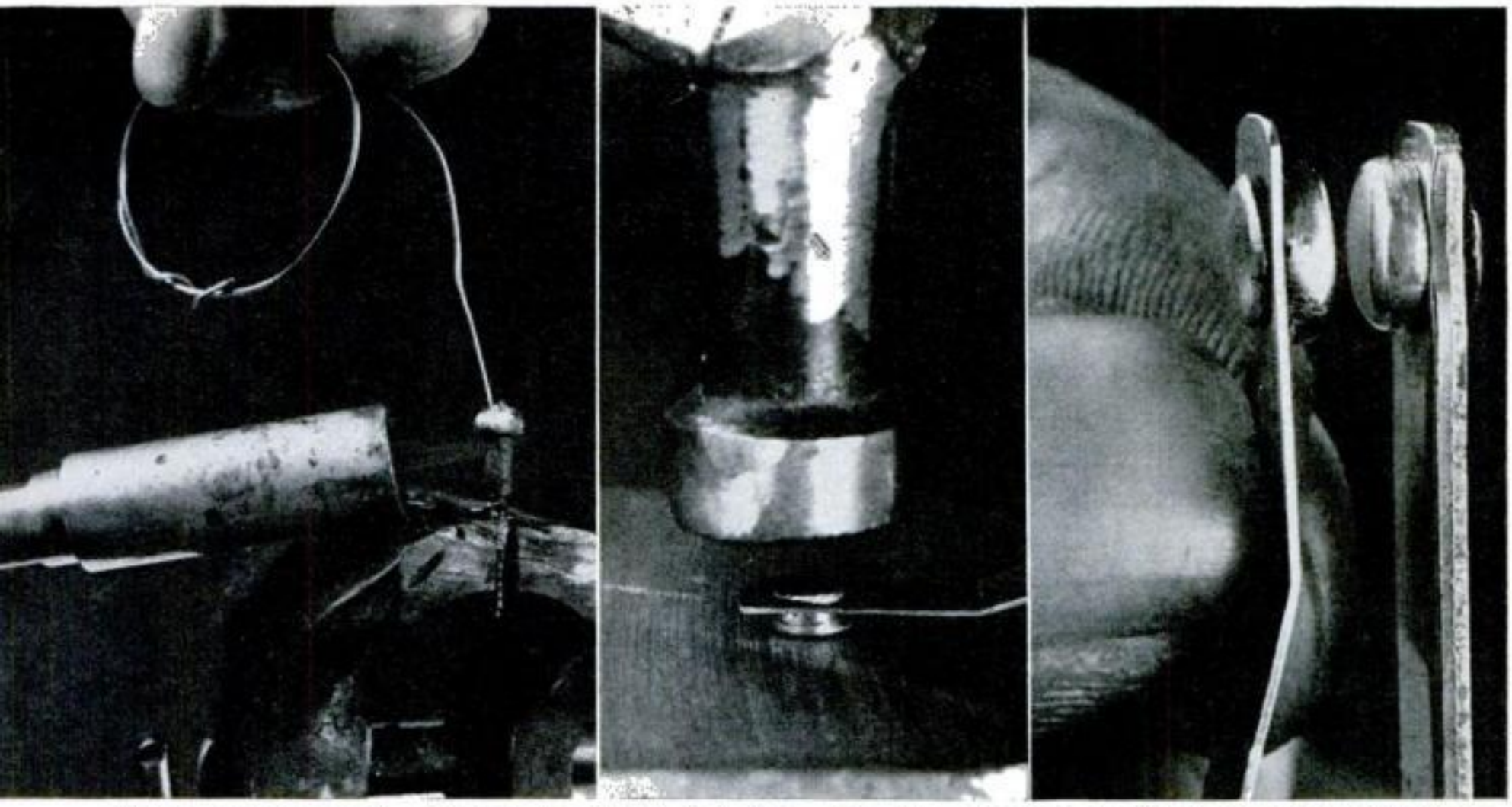
Urheberrechtlich geschütztes Material



Make replacement contacts by filing flat the heads of small roundhead screws and melting a little silver solder on them with a propane torch. Chuck each screw in an electric drill and file the silvered head to a crowned button. Then clip the shanks and rivet the buttons to the contact spring and bracket (center). The new contacts (right) will have a long life.

CONTACTS That Count

SHOP MOTOR

If it doesn't start properly, check contacts inside one bell housing. These contacts, normally closed, energize the motor's starting windings, then are opened by a centrifugal mechanism as the rotor reaches speed. Look for (1) sawdust that prevents operation of the contacts, or (2) a broken lead to the movable contact. Either one of these troubles is easily remedied.

ELECTRIC FRYING PAN

If it heats erratically or fails, burned contacts in this handy accessory's heat-controlling thermostat are probably the cause. Most makes have leaf-spring-mounted points (controlled by a bimetallic element) that carry heavy current and make and break frequently. Simply cleaning these contacts generally will restore the electric skillet to normal operation.

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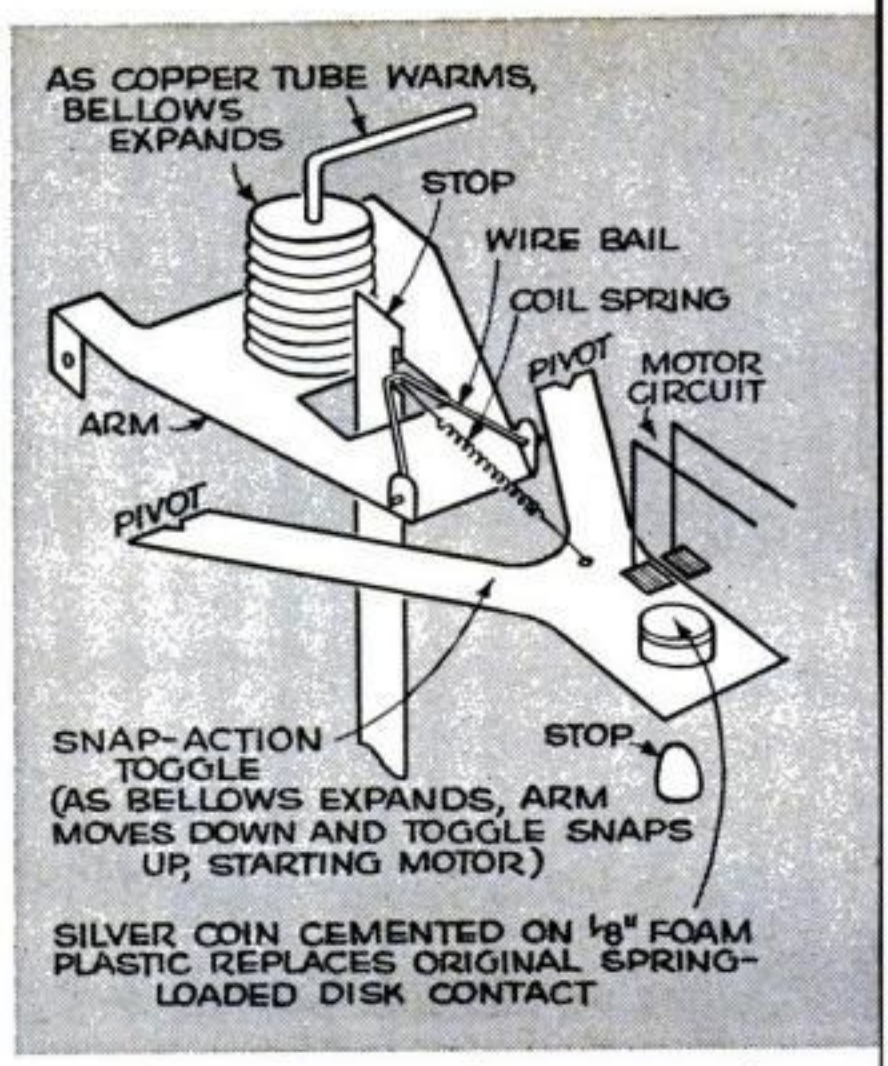
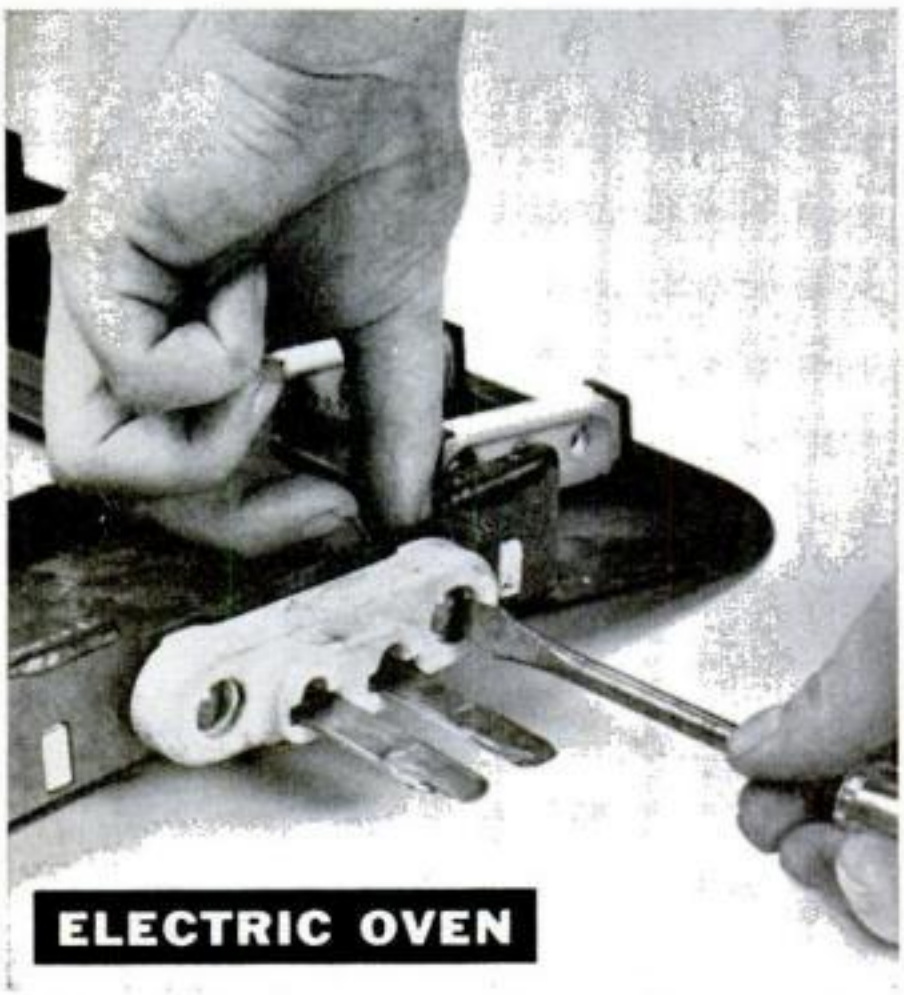
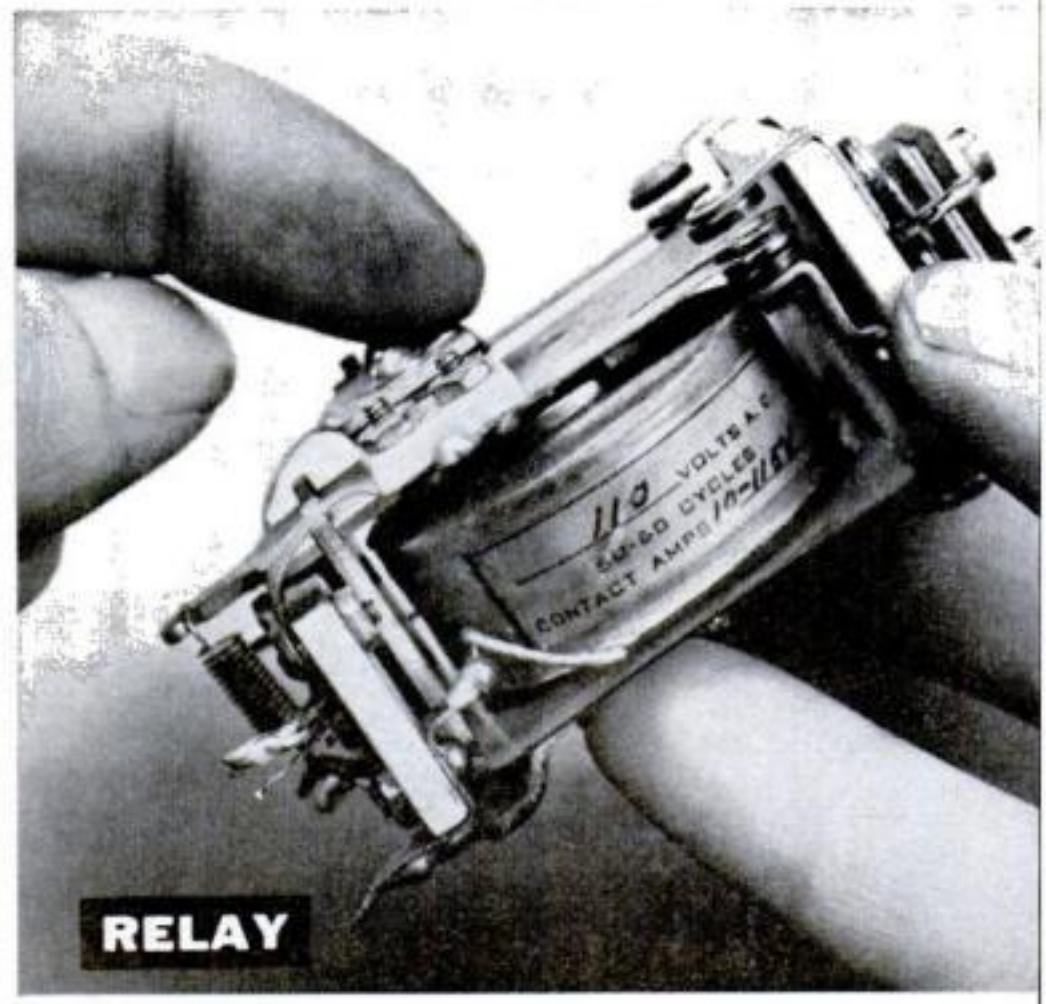


If normal off-on cycling ends, there's trouble in the thermostatic switch. A spring-loaded, silver-plated contact disk (sketch) connects two terminals to complete motor circuit. In time, the disk burns; it may fail to make contact or may stick between terminals. You can replace it with a dime-size foreign coin of silver, cemented with Pliobond to a ½" circle of ⅛"-thick polyurethane foam. File top face of coin flat, cement bottom to foam, and cement foam to toggle. This simple repair will last for years, faithfully controlling the cycling.



If the heating element seems good, check the connections to its receptacle, which has clip-type contacts that grip the element unit's prongs. Clips and prongs usually are made of copper-plated steel. When the copper oxidizes away, heavy current through the steel-to-steel contacts causes arcing, and the copper-wire leads to the clips soon burn off. To end this common trouble, remove the female receptacle, clean the clips, and reconnect the leads. Then remove the prongs and, with a torch, coat the ends with silver solder or brass brazing rod.



If the points burn and fail, the trouble usually is caused by a poorly adjusted spring in the relay. Armatures of many 115-volt relays carry leaf-spring-mounted silver contacts that operate between pairs of fixed contacts for double-throw switching. First of all, check to see that the movable points in such relays contact both fixed points with a positive pressure. Otherwise, the points will bounce as they operate. This make-and-break action causes arcing that soon burns them. Bend the leaf spring to equalize pressure on the contacts and prevent bounce.

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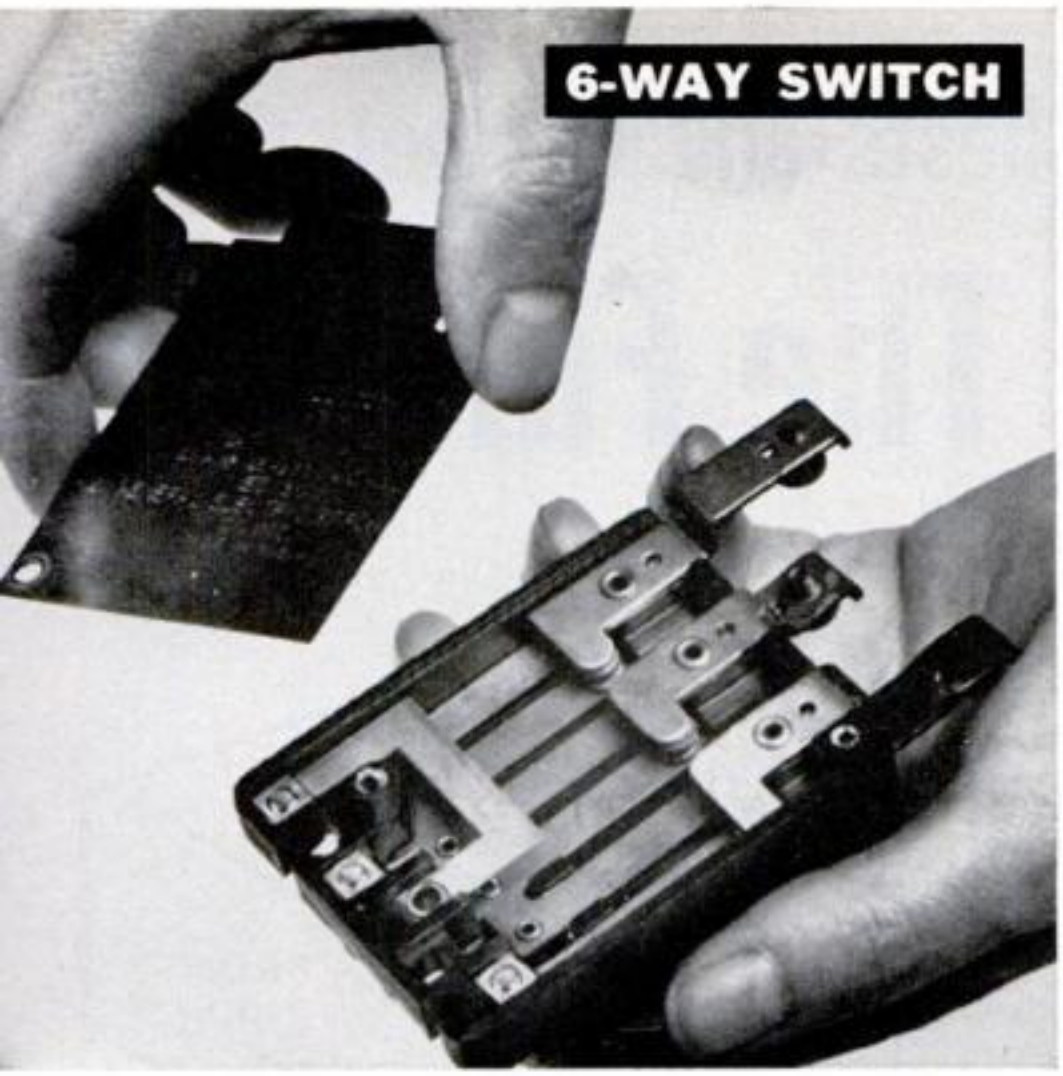
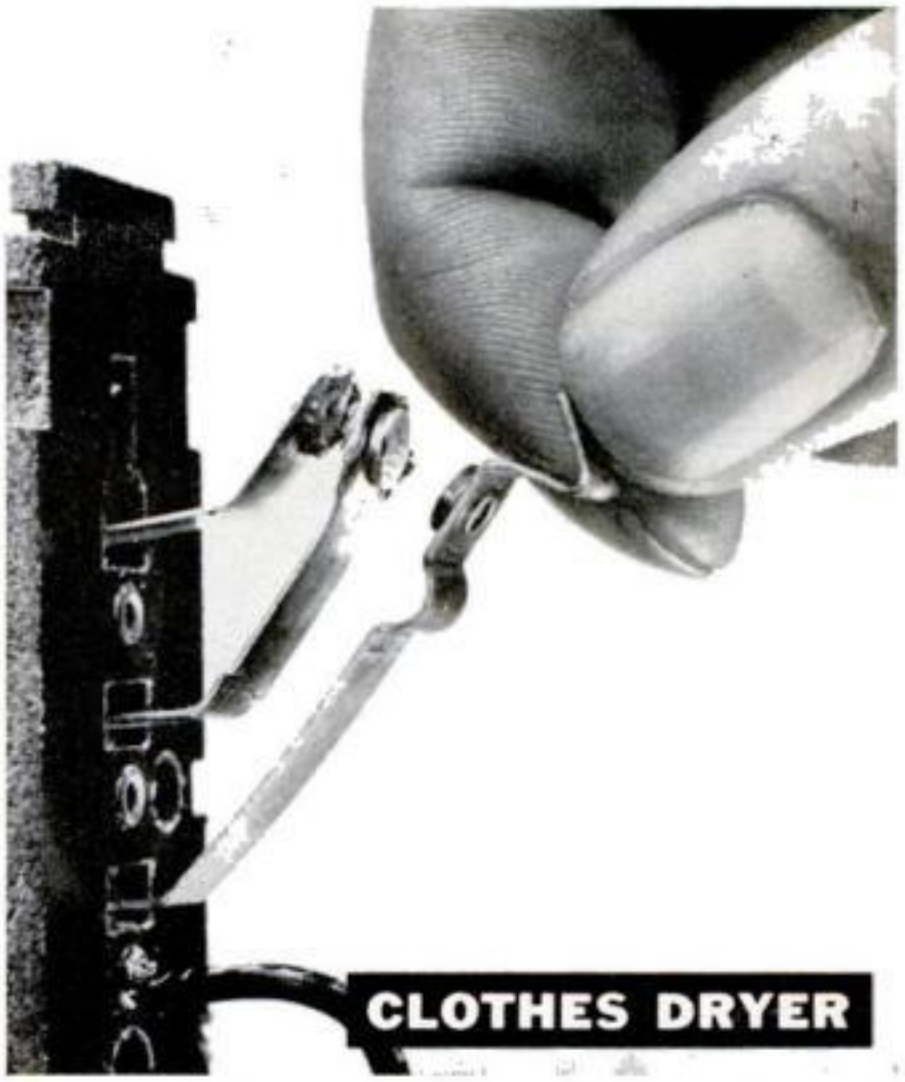


If it fails to work in some positions, a multi-heat switch controlling a range-top heating element may simply be dirty. Such switches have a rotary cam that, through pushpins, closes six sets of leaf-spring-mounted contact points in various combinations. Remove the switch's back panel by drilling out the rivets holding it. Clean the contacts and bend the springs lightly if necessary. Replace the back panel with machine screws and nuts.



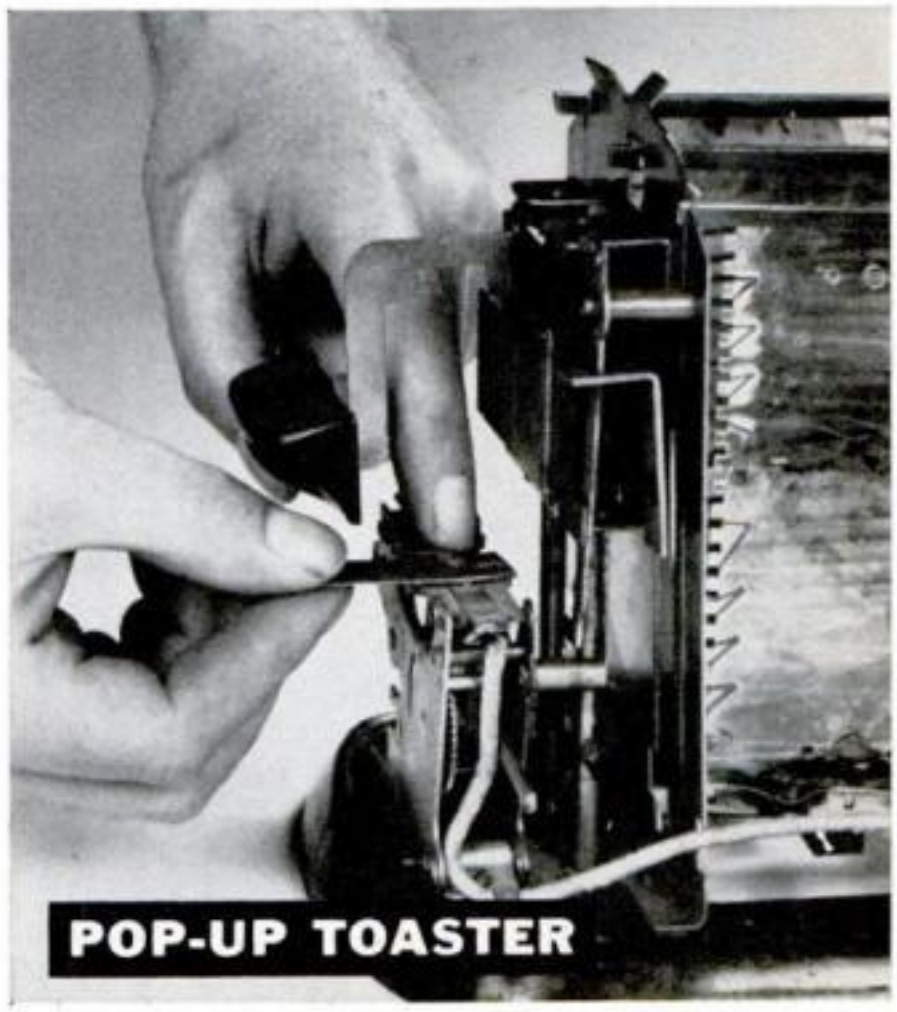
If the trouble is in the gang contacts that control the motor and heating-element circuits: In operation, the points close in sequence, the first pair contacting (to start the motor), then moving on to contact the third (to energize the heating element). The contact assembly shown failed when the second set of points welded together and wouldn't break normally. Installing a replacement assembly—inexpensive and easy to obtain—was a simple repair job.

far more dependable. Silver oxidizes slowly. Since an arc reduces silver oxide to pure metal, oxide films on silver or silver-faced base-metal contacts seldom cause failure. Provided silver points meet with fairly firm pressure and stay in alignment (misalignment may cause welding), silver-to-silver contacts give reliable service in high-amp appliance circuits.

Tungsten-alloy points, which resist welding, are frequently used in contact assemblies carrying less than 10 amps and operating in rapid cycle.

First, look at the points. It's surprising how often it's possible to dodge a bill for an appliance-repair job simply by examining a malfunctioning machine's contact points—and the spring, lever, or cam mechanism that actuates them. If you find the points burned, repairing the appliance yourself should be easy.

Merely cleaning the points may put the device back to work. When you find contacts that are hopelessly burned, replacing them with brass or steel buttons faced with silver solder is a good expedient. ■ ■



If a toaster conks out, chances are you'll find the failure in the clockwork switch that (1) operates contacts controlling the heating-element circuit, and (2) triggers a spring-loaded pop-up mechanism. After removing the toaster's chromed housing, lube the clockwork switch, clean the contact points, and grease the rails on which the pop-up assembly rides.

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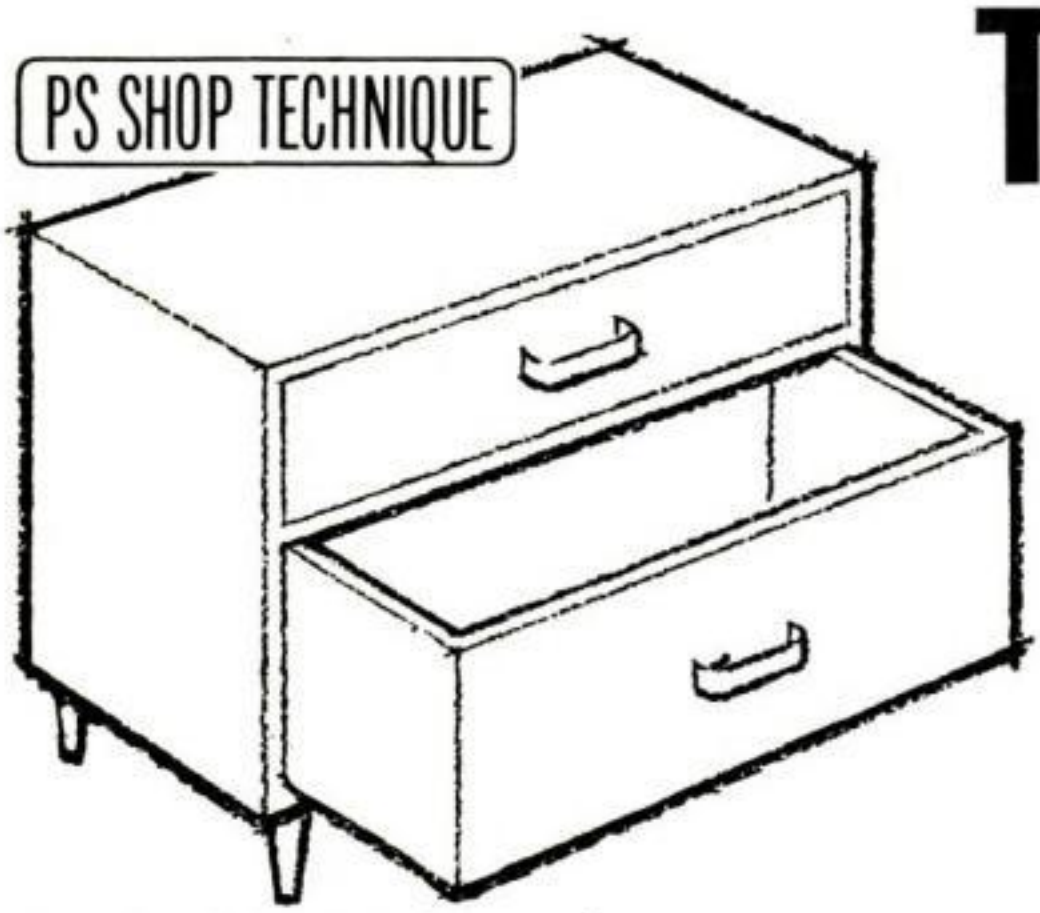
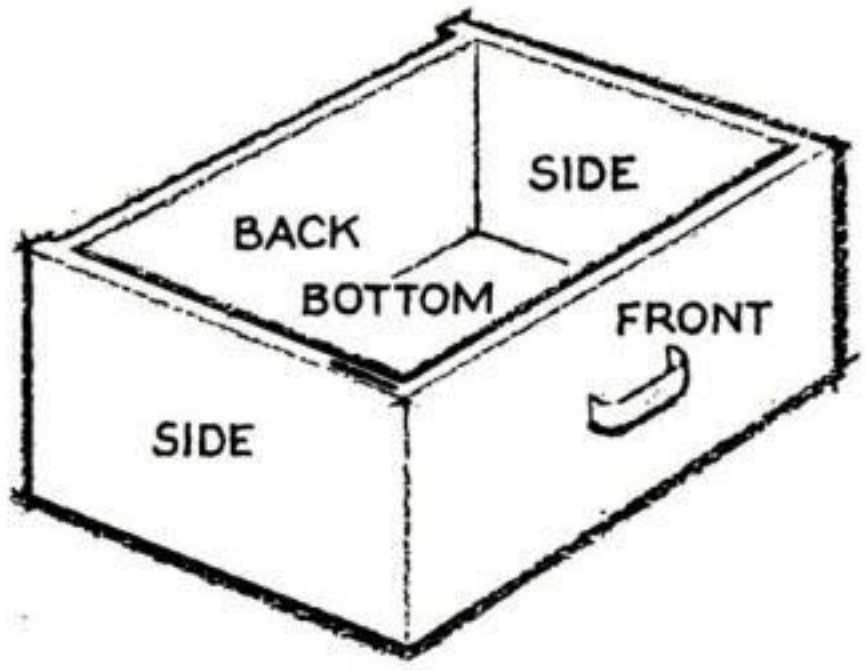
The ABCs of Building Chests and Cabinets:

The Fine Art

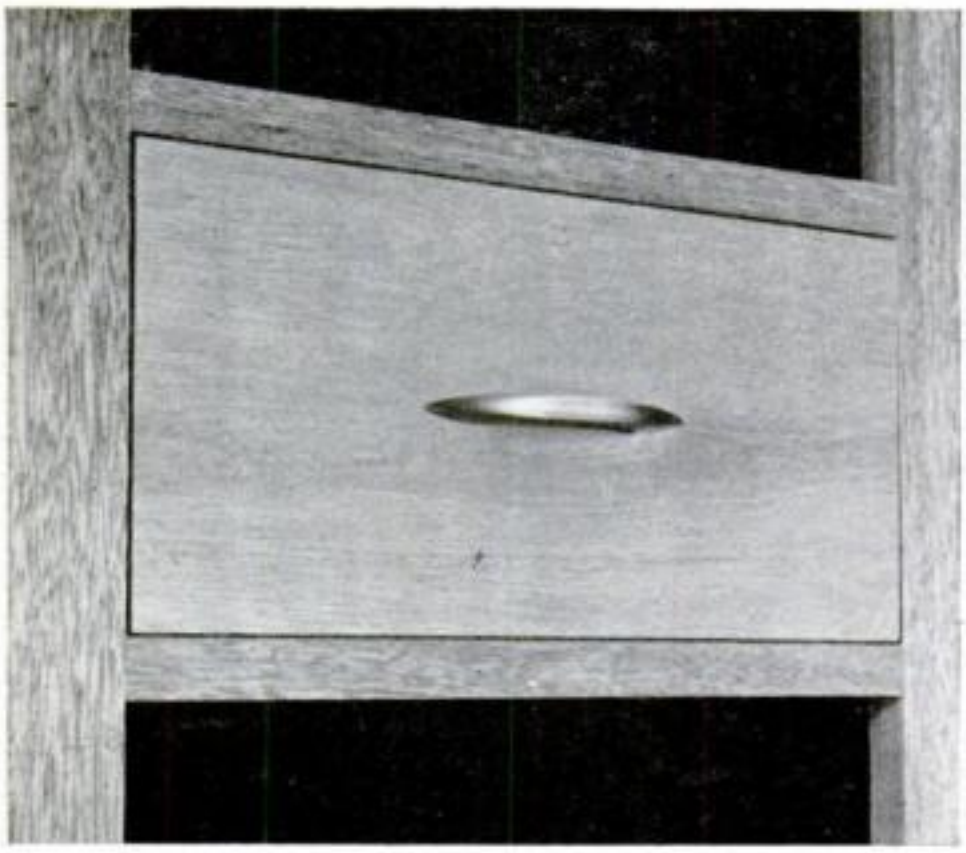
PS SHOP TECHNIQUE



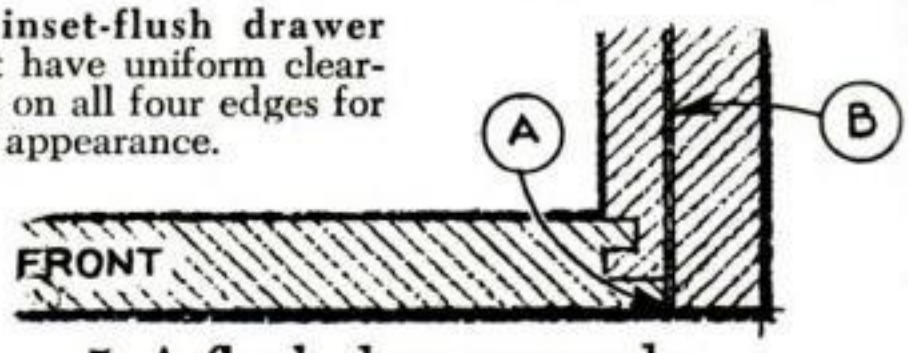
1. Start by thinking of a drawer as just a simple sliding box



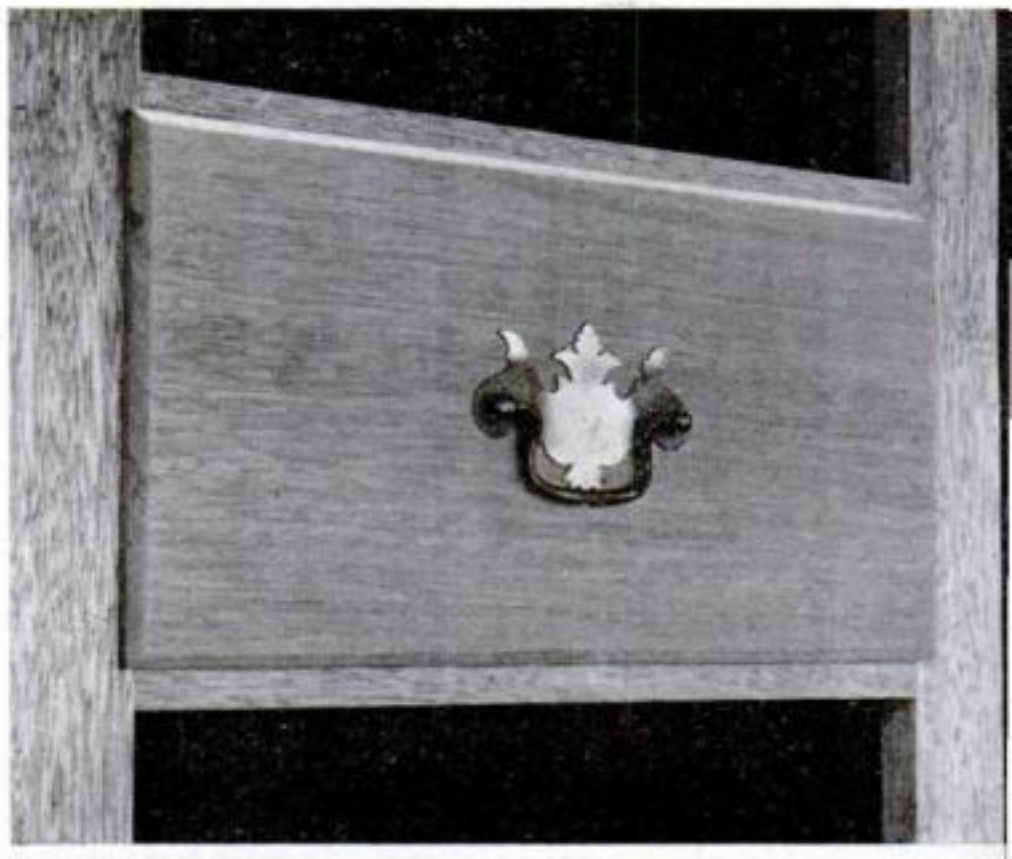
2. It has these parts



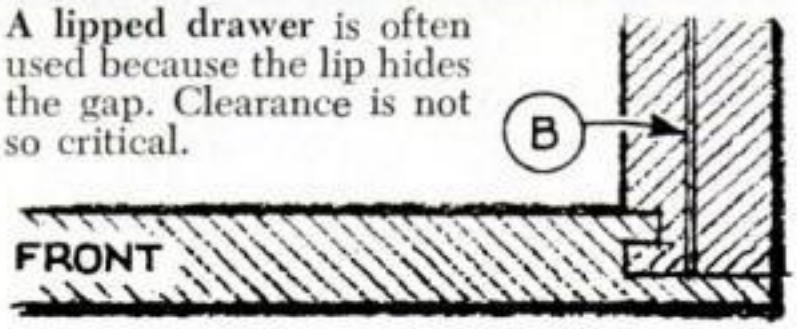
An inset-flush drawer must have uniform clearance on all four edges for best appearance.



5. A flush drawer needs clearance at A and B



A lipped drawer is often used because the lip hides the gap. Clearance is not so critical.



6. A lipped drawer needs clearance only at B

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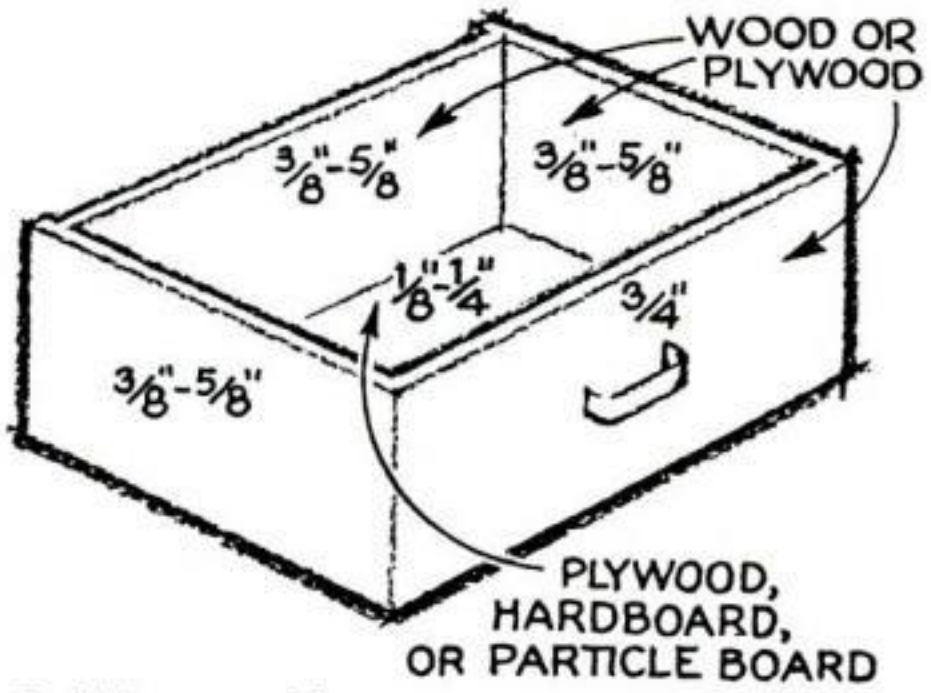
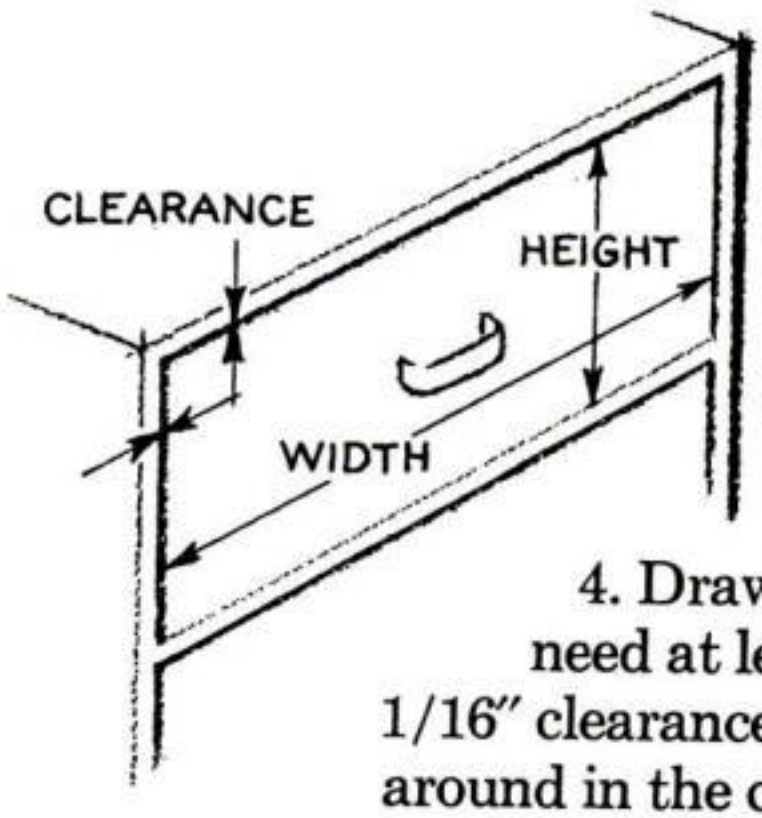
# of Drawer Making

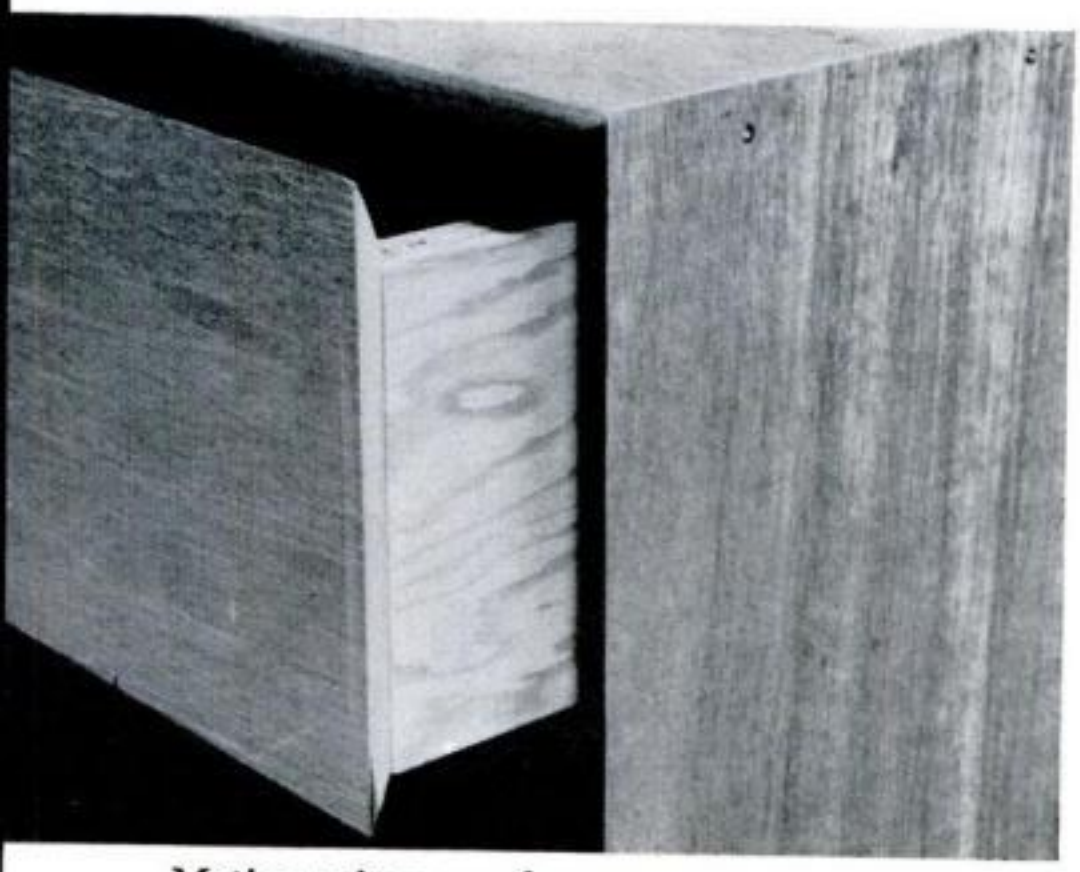
By R. J. De Cristoforo



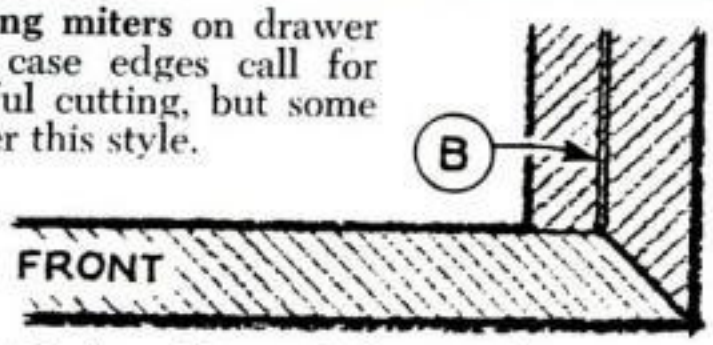
3. It's usually made of these materials



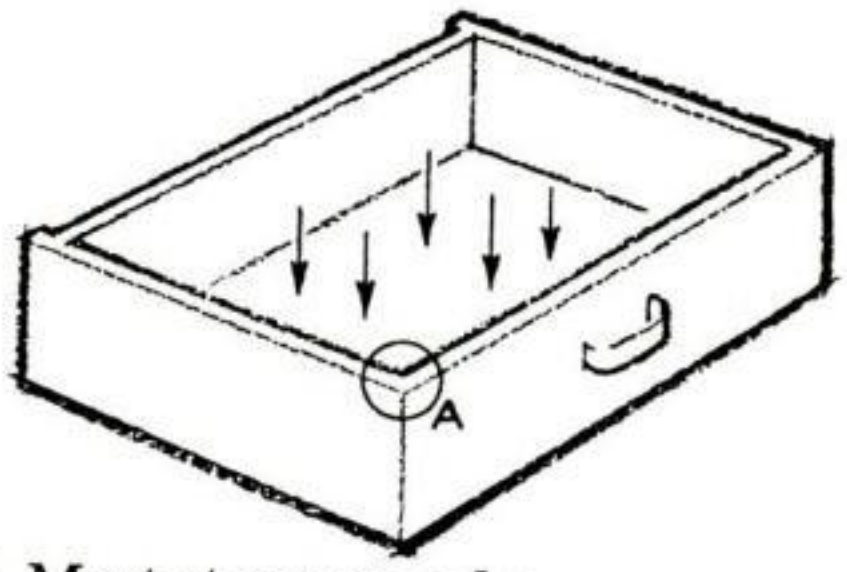
4. Drawers need at least 1/16" clearance all around in the case



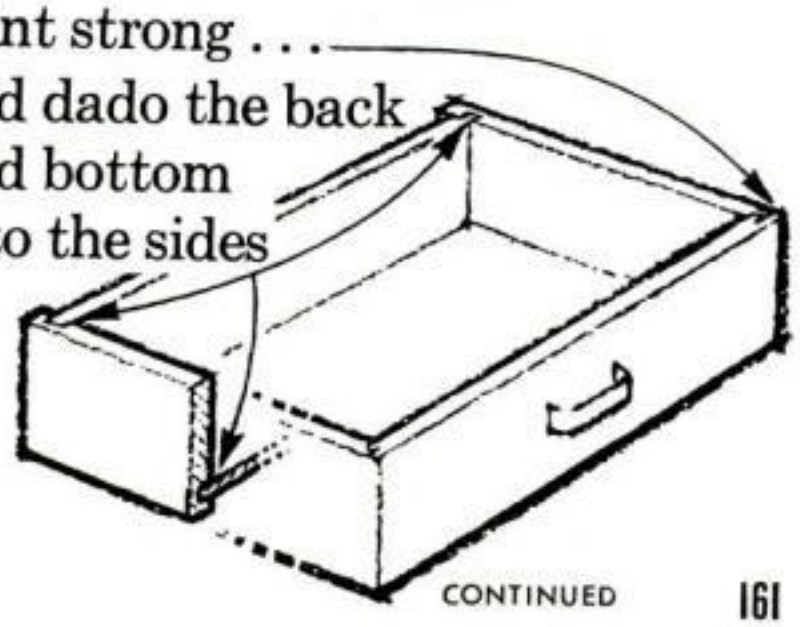
Mating miters on drawer and case edges call for careful cutting, but some prefer this style.



7. A mitered-front drawer also needs it only at B



8. Most stress on a drawer is on A and bottom. So make side-to-front joint strong . . . and dado the back and bottom into the sides



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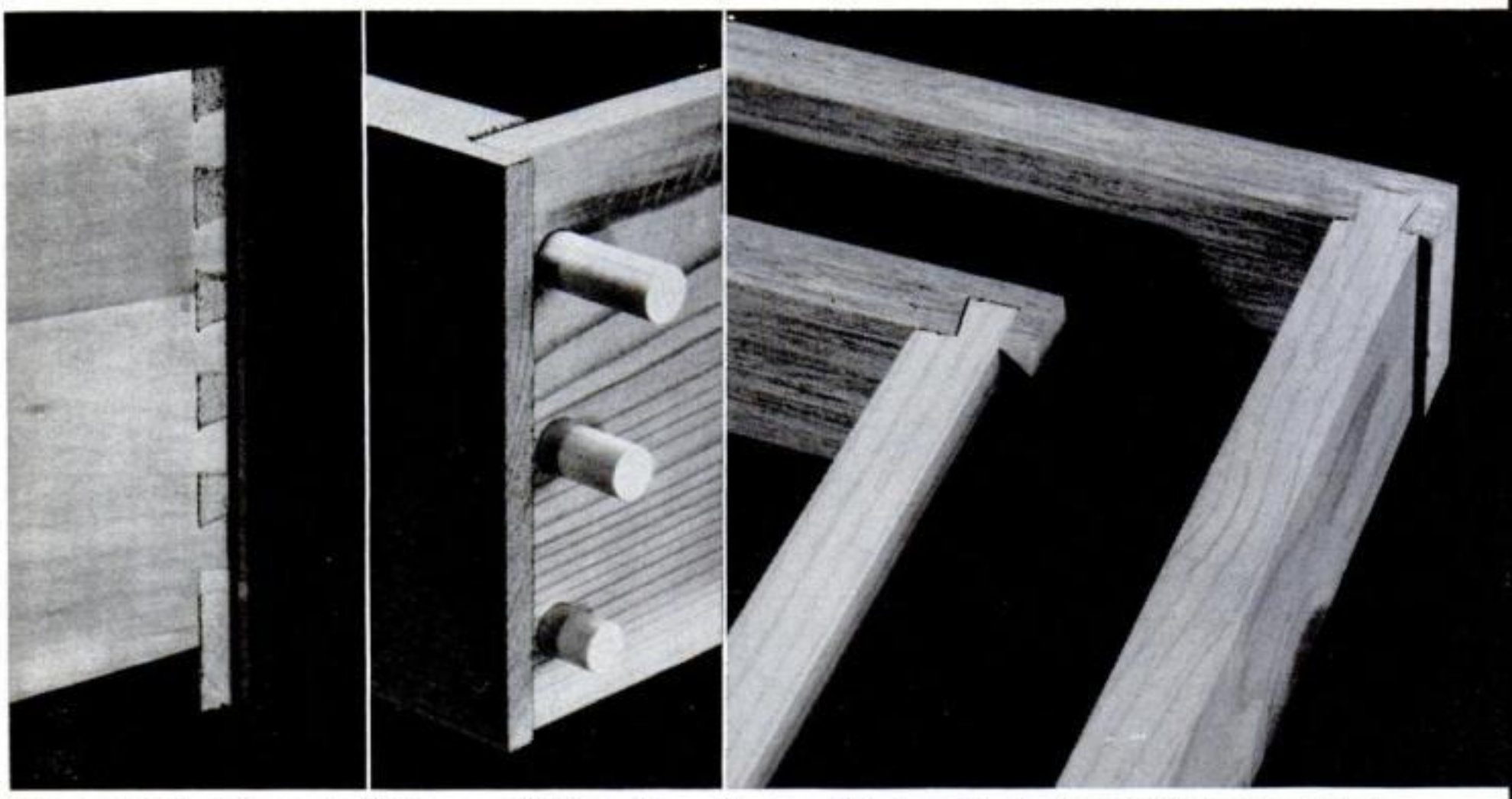
Urheberrechtlich geschütztes Material

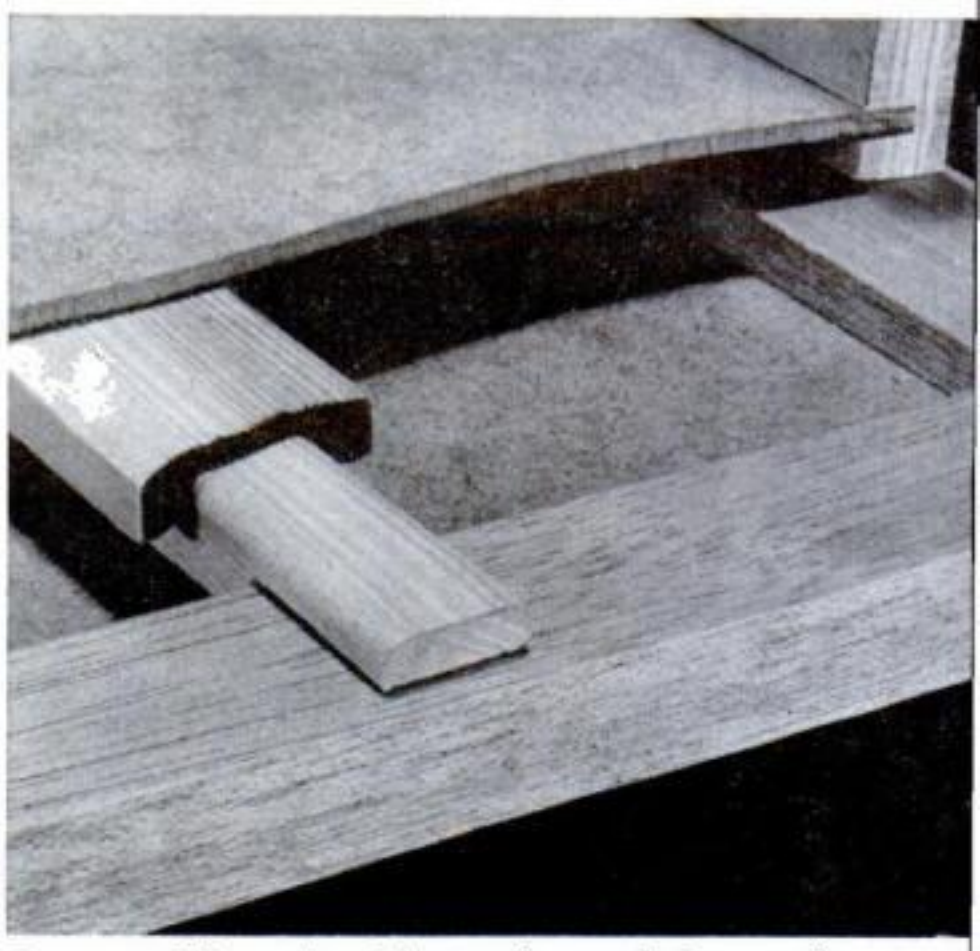
The joints to use in drawer making



The dovetail (above, left) is an old favorite, but cutting it takes time unless you have special tools. A better bet nowadays is a combination rabbet and dowel joint (center), usable for both flush and lipped fronts. Use dowels one-third the thickness of the front. Drill for them while the side is clamped into the rabbet. Clamp the assembly until glue sets. Then cut the dowels flush. A single dovetail into the drawer face is also easy to do with a table saw. As seen above, you can cut either a single- or a double-sided tongue. Clean out the

A drawer bottom should fit loosely in grooves cut in the sides and front. Make the width of the groove just a shade more than the thickness of the bottom material. Limit the groove depth to half the thickness of the drawer sides. Secure the bottom as shown with small nails driven through it and into the drawer back. Don't glue the bottom at any point.

How to



Center slide-and-guide is favored by professional cabinetmakers for mounting a drawer because it's efficient, easy to install. Nail the U-shaped slide to drawer, attach guide to front and back rails. Two thumbtacks in bottom edge of each drawer side smooth the action.

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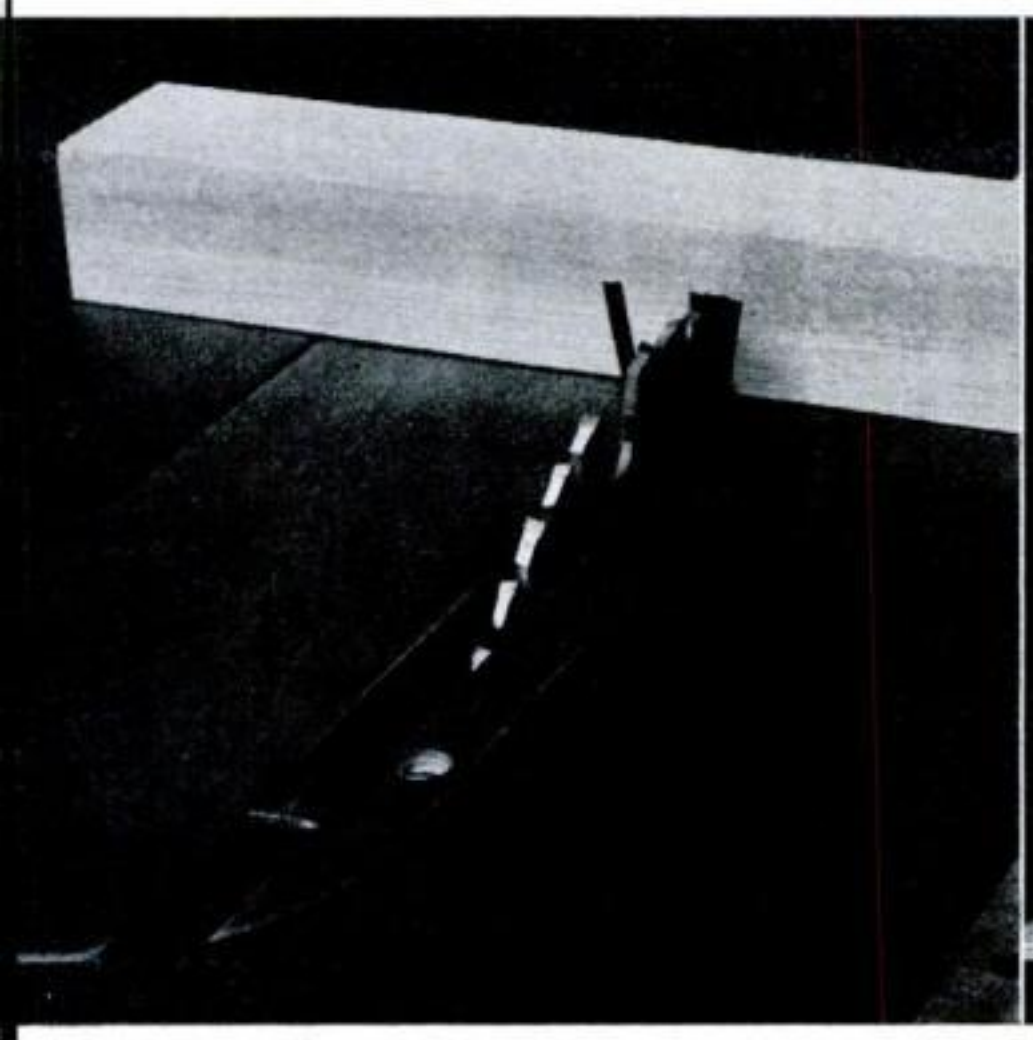
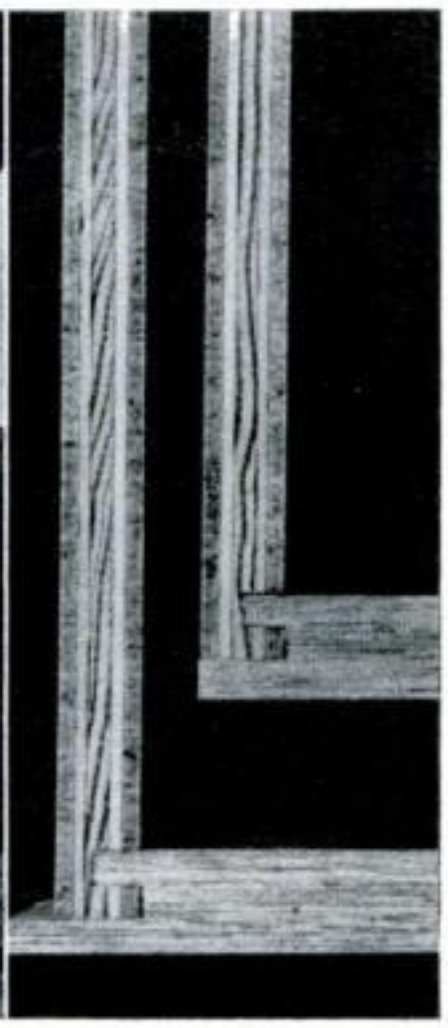
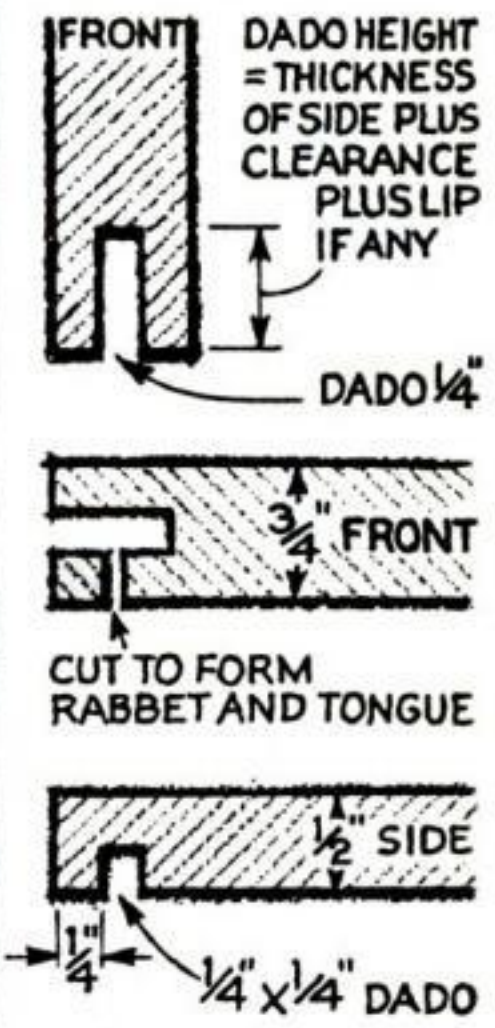


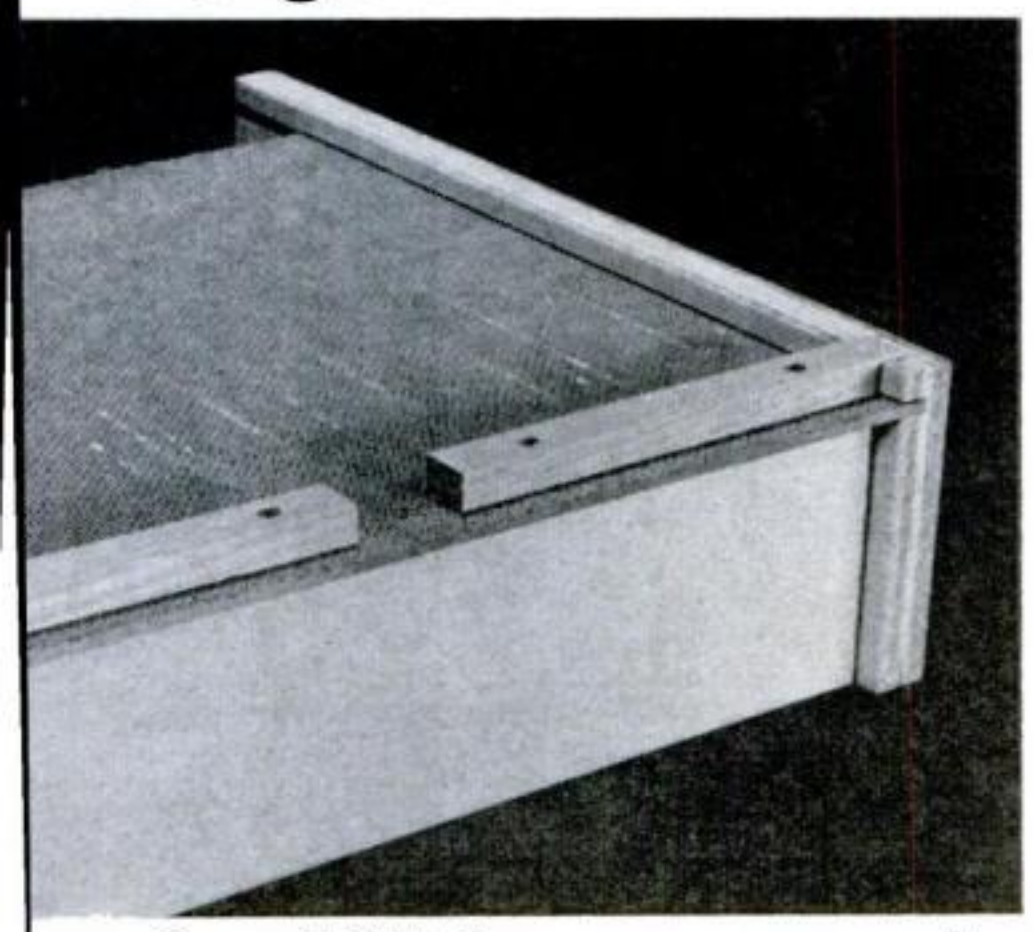




groove by making successive passes with the saw blade. If the blade cuts a ⅛" kerf, use an angle of not more than 10 degrees. Limit the depth of cut to two-thirds of the drawer-front thickness. Cut the tongue by setting rip fence to the left side of the saw blade.

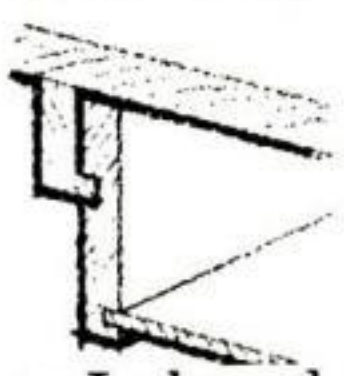
Rabbet-and-groove is another good joint for a drawer front. Make it by repeat passes with a regular blade or by using a dado. Cut a deep dado into the end of the face, slice off one tongue, and groove the side. Photo shows joints cut for both a flush and a lipped drawer.

hang a drawer

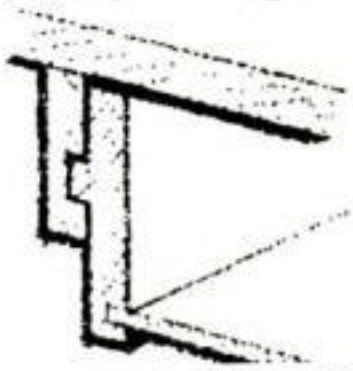


On small light drawers you can use an alternate to the center slide-and-guide. Eliminate the slide and use two cleats on the bottom of the drawer, nailing them to the back as above. Space the opening between the cleats to suit a guide strip attached to the case.

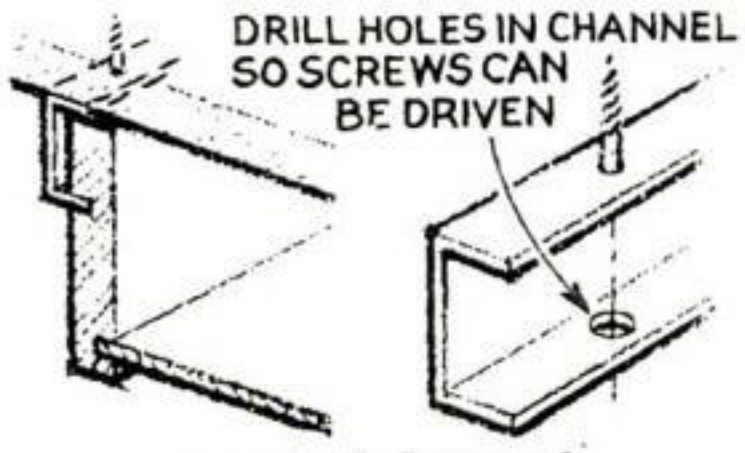
You can put a drawer under a table or workbench by using . . .



an L-shaped hanger . . .



a grooved hanger . . .



a metal channel.

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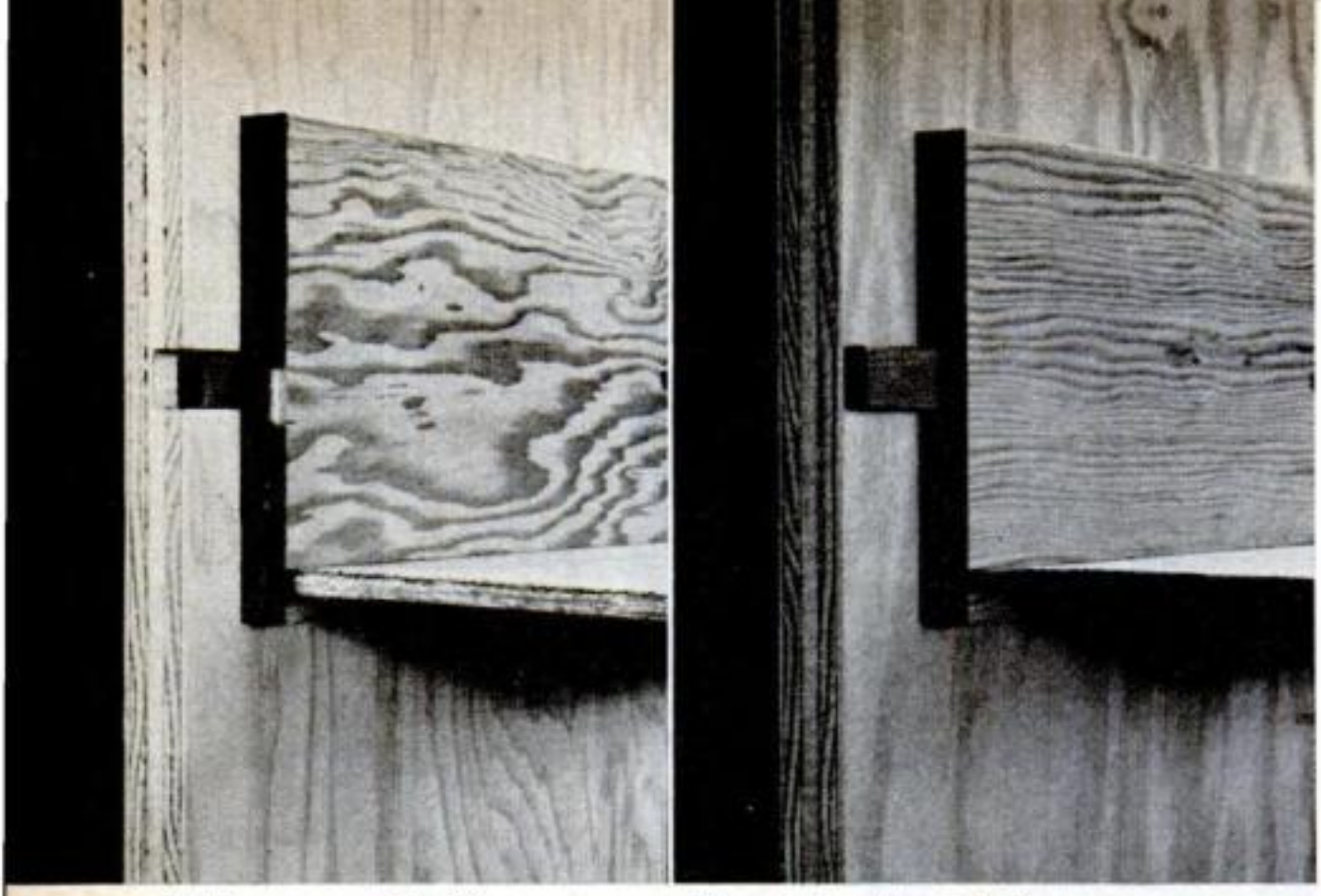
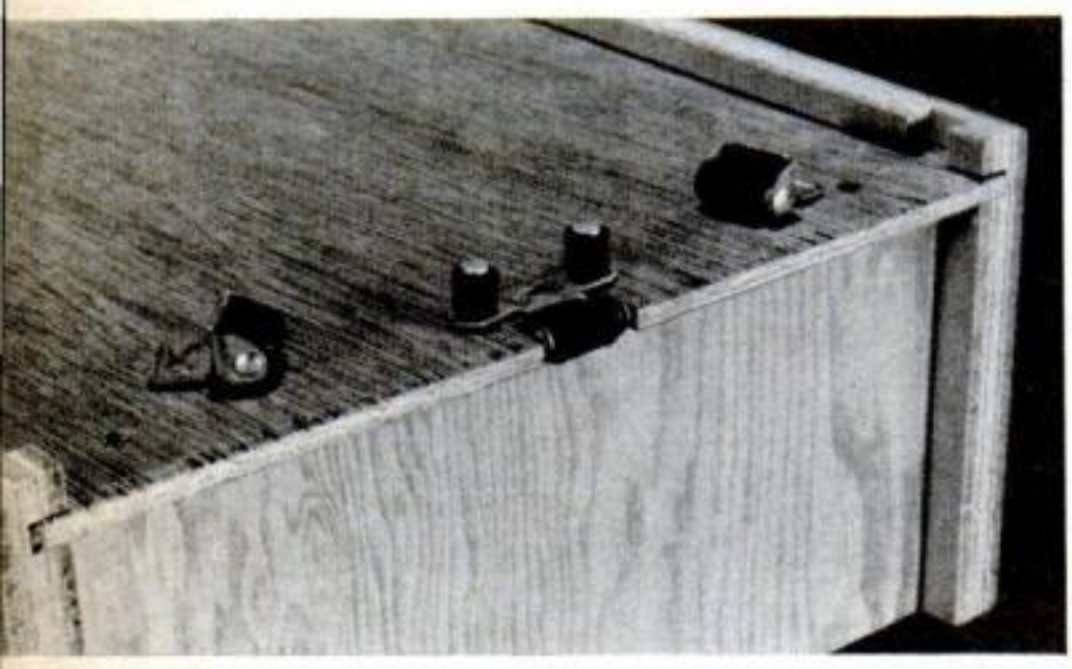
Urheberrechtlich geschütztes Material



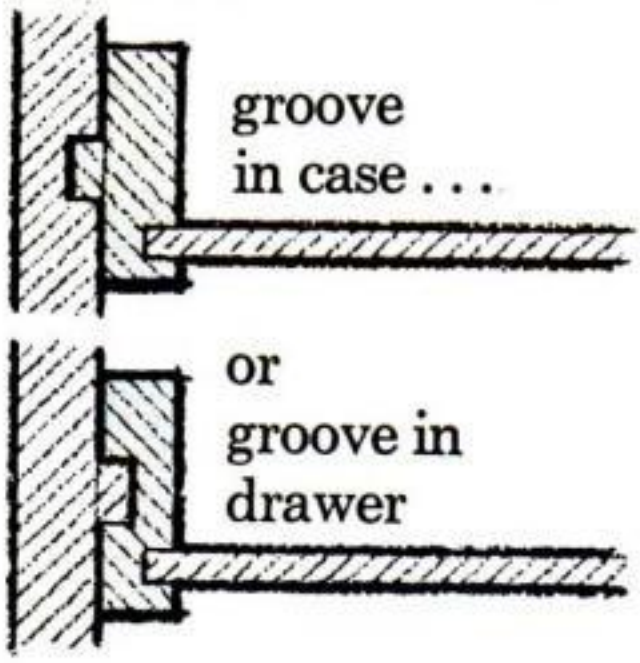
When you build a case without horizontal frames, you can mount drawers by one of the two methods shown here. First, you can attach runners to the drawer sides to ride in grooves cut in the case sides. Or you can do the reverse—attach the runner to the case and cut a groove in the side of the drawer (especially good for adding a drawer to an existing case).



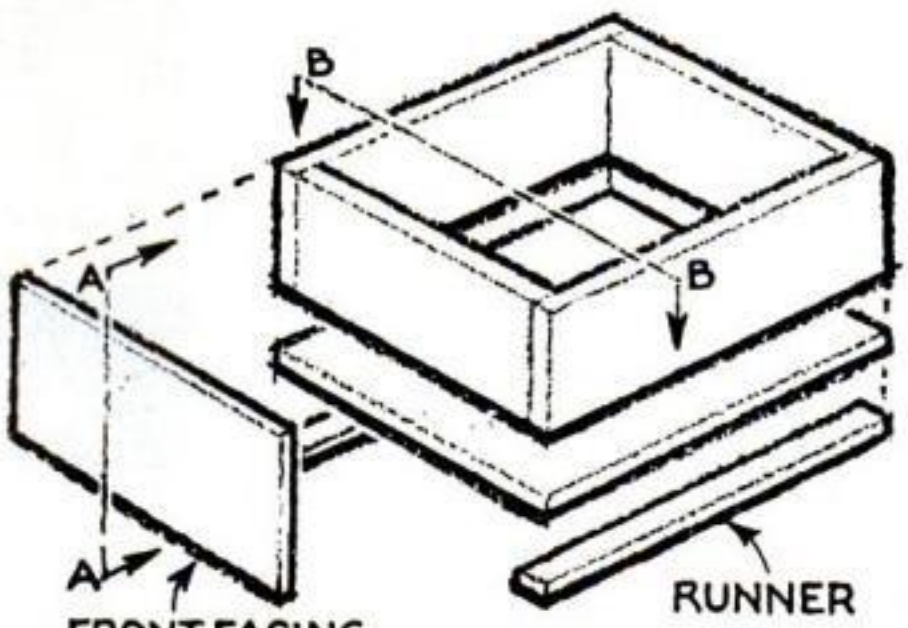
You can buy various fittings for installing drawers. Many make the job easier. The set of nylon rollers above costs less than 50 cents. The two unattached ones go on the front rail for edges of drawer sides to ride on. They're made by Junior-Pro, 188 E. Marceau, St. Louis 11.

Plan the interiors of drawers for the particular items that are to be stored—unpartitioned drawers usually end up as storage bins. In the fitted drawer below, a sliding tray separates buttons and other small sewing supplies and makes everything easy to find at a glance.

Keep clearance to minimum when the drawer guide fits into . . .

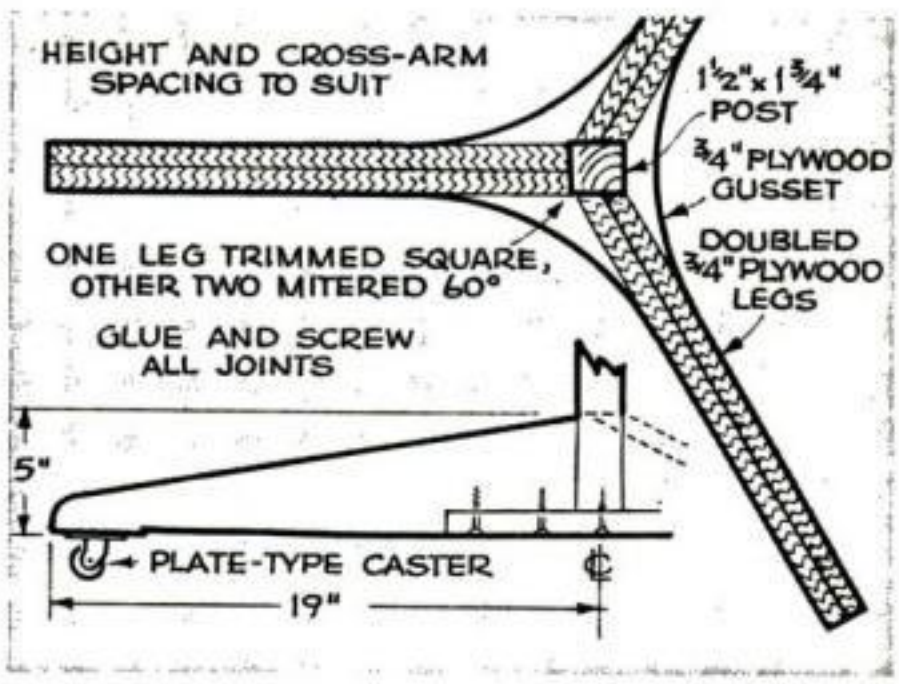


An easy way to make a drawer



All parts must be square to each other, and the assembly of the drawer sides, front, and back must be rigid and strong *before* you install the bottom. Remember this and you're on your way to quality construction. At times—for shop drawers, say—you can skip some fine points on previous pages. These sketches show how to reduce construction to its simplest form—butt joints nailed and perhaps glued. Just keep everything square. ■ ■

Urheberrechtlich geschütztes Material

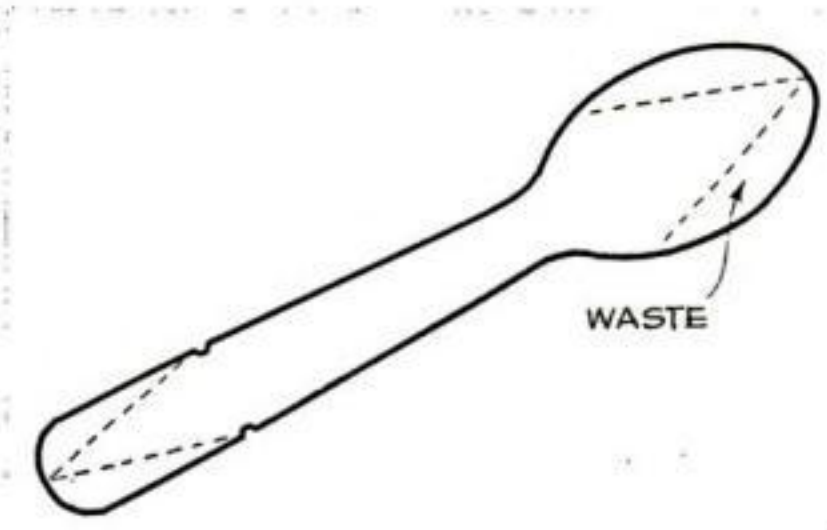


Sturdy stand for ganged photo reflectors

This homegrown tree-type light stand helps overcome the amateur photographer's lack of adequate lighting equipment. Using it, I can gang a number of inexpensive photoflood reflectors when I need a broad-source flood unit.

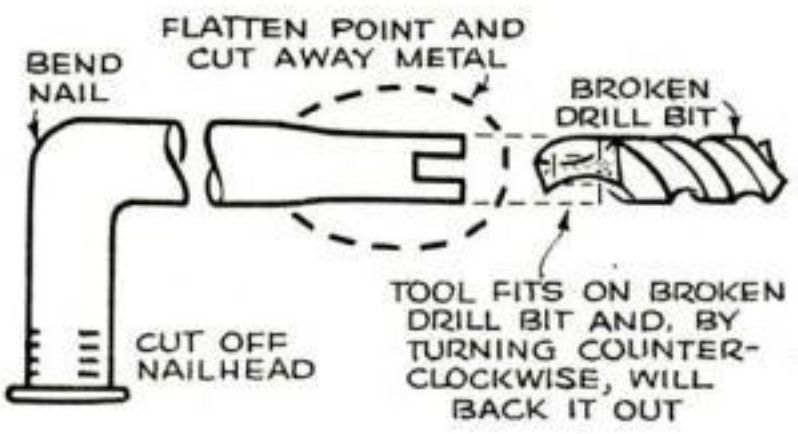
The stand is just a three-legged upright with crossbars. You can stud-mount the reflectors or use spring clamps.

The doubled ¾"-plywood legs butt against the upright. A notched-in gusset strengthens the joints. For 12"-diameter reflectors, space the arms 12" apart.—*John Burroughs, Tacoma, Wash.*



Wooden spoon makes tile work a picnic

An ordinary wooden picnic spoon becomes a tool for tile jobs when both ends are sharpened to a point with a chisel, as in the drawing above. I found that it cleans out excessive grout from between plastic tiles faster than the pencils or round toothpicks I had been using previously.—*John F. Baas, Detroit, Mich.*

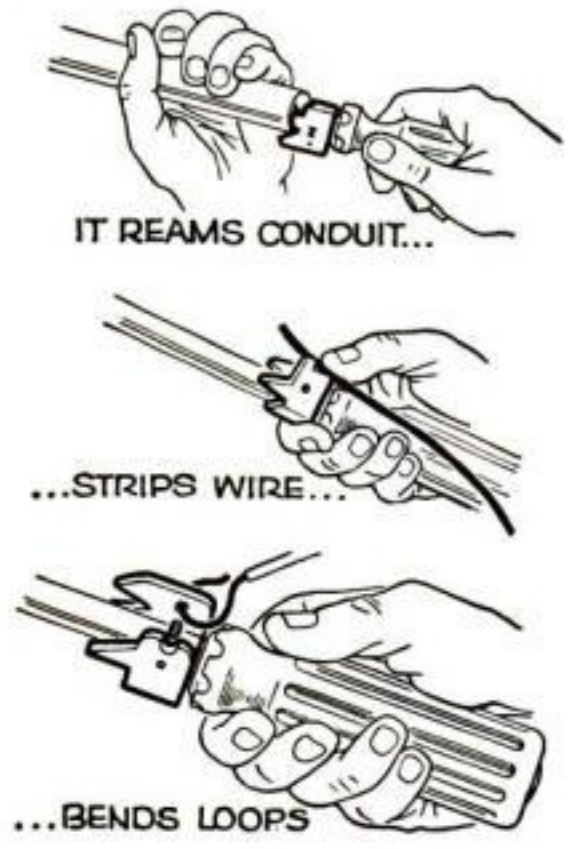

BEND NAIL
FLATTEN POINT AND CUT AWAY METAL
BROKEN DRILL BIT
CUT OFF NAILHEAD
TOOL FITS ON BROKEN DRILL BIT AND, BY TURNING COUNTER-CLOCKWISE, WILL BACK IT OUT

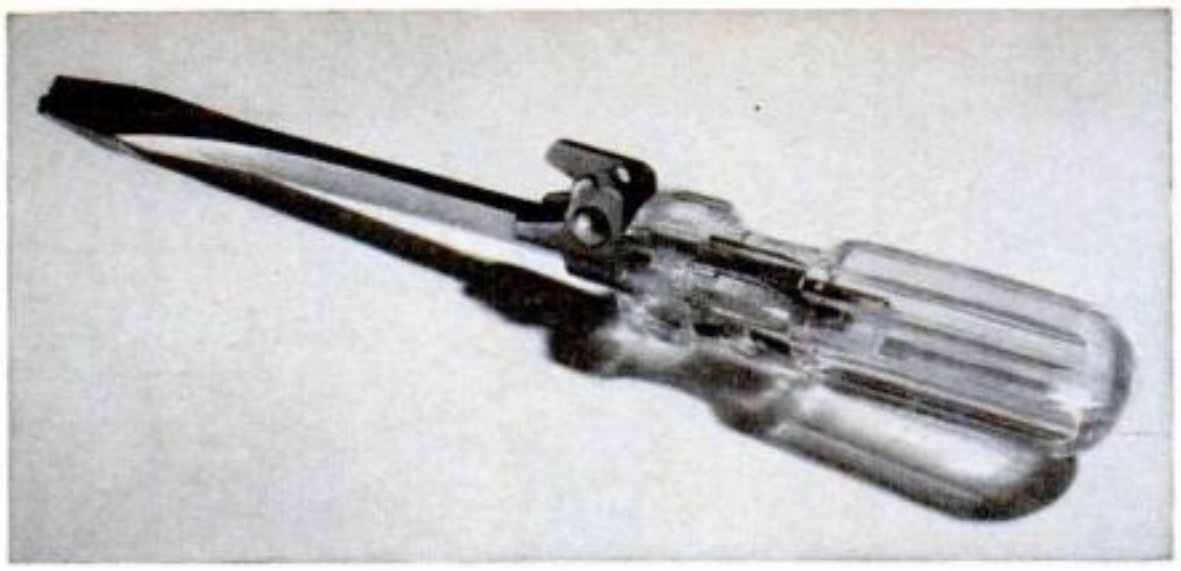
Backing out of a tight drill spot

I made a nail into a useful tool for removing a drill-bit fragment that breaks off below wood surfaces. Remove the head and bend the nail, as illustrated above. Then flatten the pointed end with a hammer and notch it with a hacksaw. Fit the notch over the broken bit grooves and twist out.—*James Stanford, St. Paul, Minn.*

Urheberrechtlich geschütztes Material

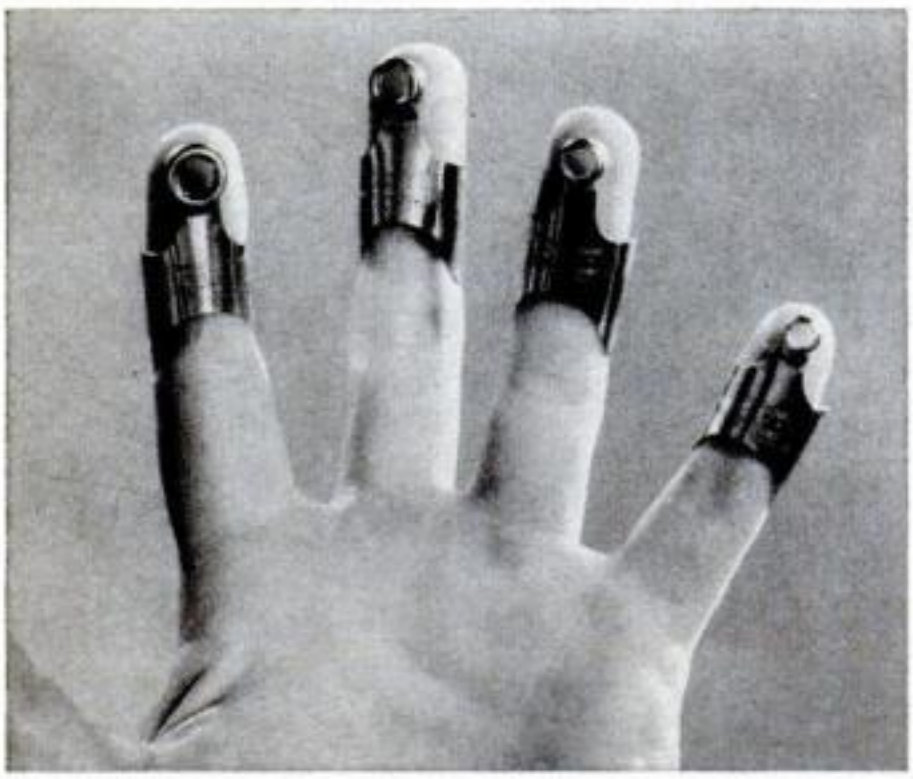
what's new in TOOLS

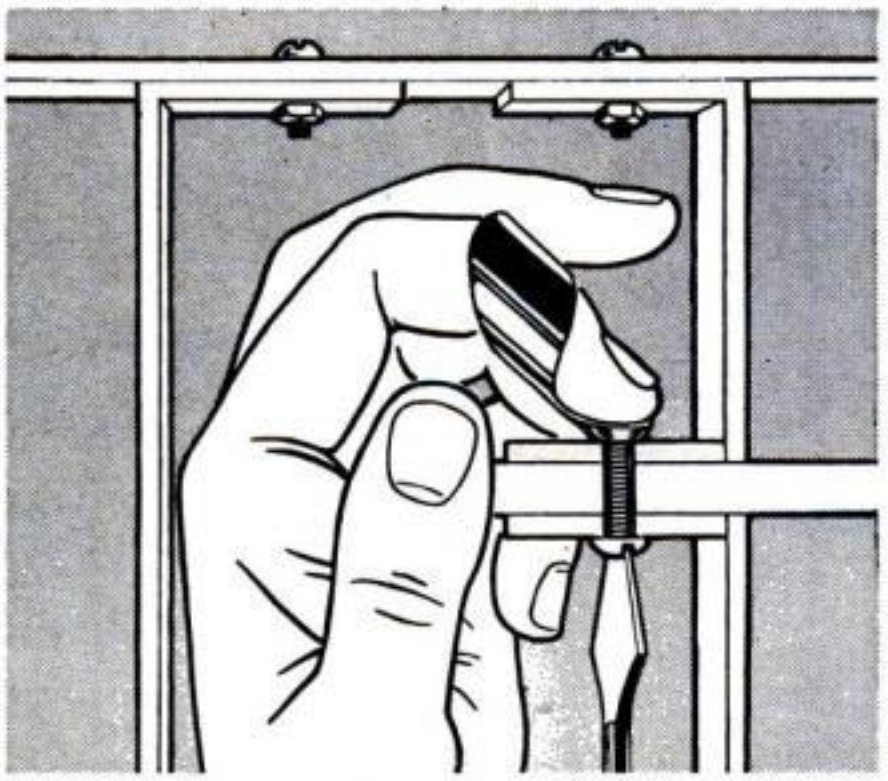




Four-in-one screwdriver speeds electrical work

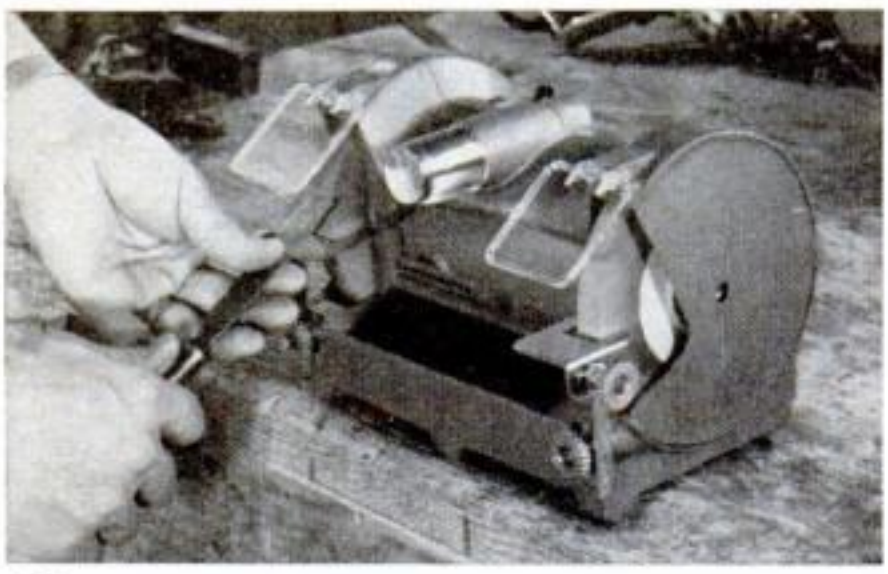
This versatile screwdriver is practically a whole toolbox when it comes to electrical wiring jobs. A V-shaped blade on the shank serves as a reamer for deburring the ends of electrical conduit. A smaller notched blade acts as a wire stripper for removal of insulation. By inserting bared wires in a hole and twisting, you can form loops on the ends for making terminal-screw connections. The tool sells for $2.25 from Piggyback Level and Tool Co., Jutland, N. J.





Finger wrenches for hard-to-hold nuts

Ever wish your finger were a wrench when you have to hold tiny nuts and bolt heads in hard-to-reach places? That's exactly what it becomes when you slip on one of these fingertip hex wrenches. The tiny wrenches come in four sizes—5/32″, 3/16″, 7/32″, and 1/4″—and sell for $2.50 a set from Value Village, P.O. Box 501, Buffalo, 5, N. Y. They have split collars that can be adjusted to fit any finger size.



Low-cost bench grinder has own motor

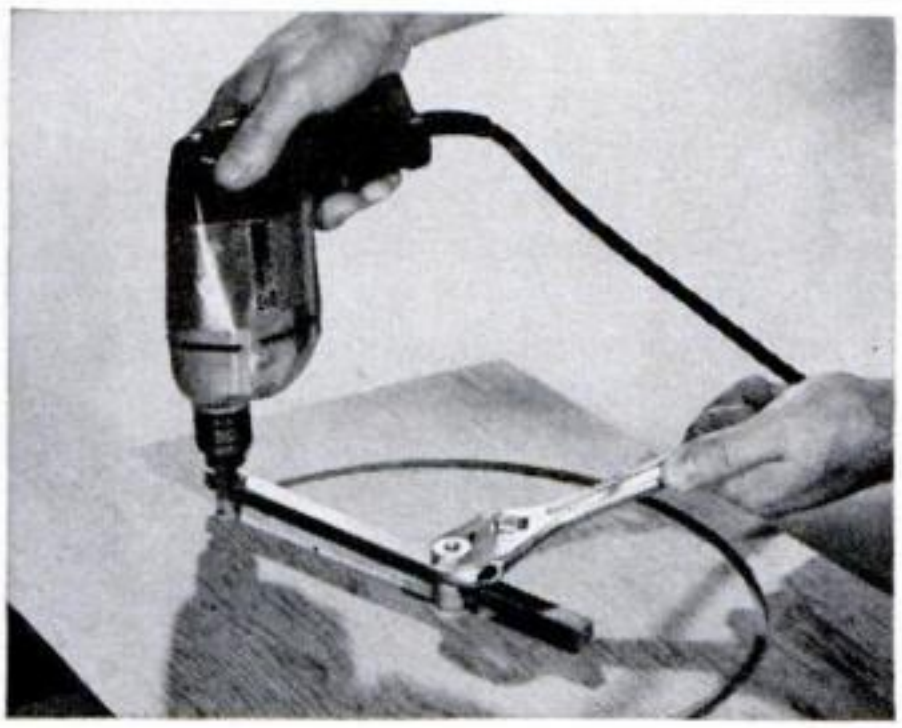
A famous name in kitchen appliances—Toastmaster—has come up with a new line of power tools. One of the nicest, an inexpensive bench grinder, has a built-in 3.2-amp motor, two 5″ wheels, and a handy work light—all for $21.88. Other tools in the line are five drills, two portable circular saws, a saber saw, and an orbital sander. Prices range from $9.88 to a top of $33.88 from Toastmaster Division, Elgin, Ill.

Urheberrechtlich geschütztes Material

SHOP TALK

By Sheldon M. Gallager

That circle cutter is back—bigger and better



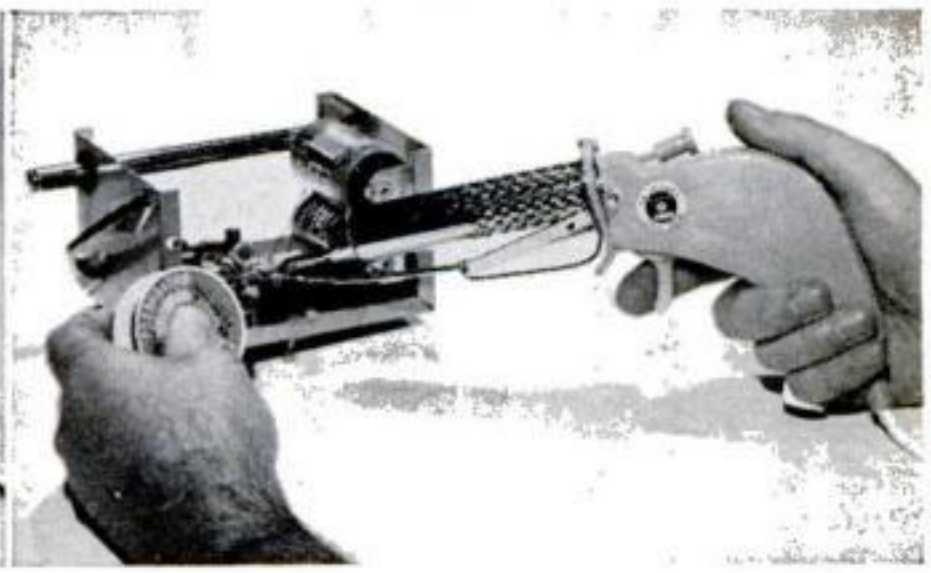
Remember that clever circle-cutting attachment for an electric drill we told you about last July ["Big Holes, Little Holes"]? It proved so popular I thought you'd like to know there's now a bigger version available. It cuts circles up to 20″ in diameter in 2″ stock—the earlier one handled 12″ circles in 1″ stock. They've added a thoughtful touch, too. The center pivot is hex-shaped instead of round so you can get a wrench on it for extra leverage in turning the drill. The tool sells for $9.95 from Silken Compass Cutter Co., Box 242, Oceanside, N.Y.

Now: Engraving tools for home shops

Electric engraving tools used to be costly, specialized machines that only a jeweler would own. Now there are low-cost versions coming on the market that sell for less than $15. They're handy for personalizing tools and jewelry, for decorative carving in metal and glass, and for precision marking in machining operations. The one shown at left operates at 7,200 vibrating strokes a minute and has an adjustable depth of cut. It sells for $14.95 from Dremel Mfg. Co., Racine, Wis. A similar tool is made by Burgess Vibrocrafters, Inc., Grayslake, Ill., and sells for about $8.

One-hand solder gun feeds the solder for you

If you always seem to be running out of hands when soldering small parts, you'll get a kick out of the soldering tool shown below. It feeds the solder for you, leaving your other hand free to hold the parts. The solder is stored in a roll in the handle (left) and feeds out a tiny tube near the tip. Pulling a trigger advances the solder as you need it. Neat, huh? The tool is actually a soldering iron but in the handy shape of a gun. It's priced at $17.95 from Porta-Power Michigan, 1120 N. Ball St., Owosso, Mich.



Urheberrechtlich geschütztes Material

HOW TO PICK THE RIGHT

Interior Clear

PS MATERIALS

WHAT do you use on interior paneling, cabinets, and other woodwork when you want to take advantage of the natural beauty of the wood—when you want the wood to show? To pick the finish that exactly meets your needs, there are several considerations.

First, how much do you want the wood to show? Should it remain about the same color? Or do you want it darker? Or perhaps another color entirely? Do you want it to retain its texture, its woodlike feel to the touch? Or do you want it to be smooth, plastic-like?

Second, how much of a beating will the finish take? Will it be dirtied and washed often? Splashed on? Rubbed, bumped, scratched? You often meet such conditions around windows and doors.

Finally, how big is the job? Is the cost

The POPULAR SCIENCE Guide to Interior Clear Finishes

KIND OF FINISH	SHEEN	COLOR EFFECT	DEGREE OF PROTECTION	NUMBER OF COATS	DRYING TIME	METHOD OF APPLICATION
GLOSSY VARNISH	High gloss	Darkens greatly	Excellent	1-2; 3 if porous	4 hours and up	Brush
SEMIGLOSS VARNISH	Satin	Medium to darkening	Very good	1—if 2 are needed, undercoat with clear varnish	4 hours and up	Brush
FLAT VARNISH	None	Same as semigloss	Not too much		Same as other varnishes	
URETHANE VARNISH	This material, satin or glossy, gives excellent protection. Read labels carefully, since performance varies, brand to brand, as does application					
PENETRATING FINISH	None	Colors deeply	Excellent to wear; good to moisture	1-2, depending on porosity of wood	Overnight to recoat	Brush or roller—then wipe
VINYL-ALKYD	Gloss or semigloss	Colors deeply	Good	Study labels; considerable variation between brands		
BRUSHING LACQUER	Semigloss	Colors very little	Good	1-2	1 hour	Brush
LIGHTENING LACQUER	Intended as a first coat only, under lacquer. Tends to darken the wood less than other materials					
SHELLAC	Semigloss	Medium	Good	Several "wash coats" of diluted shellac gives best results		
LINSEED OR SIMILAR OIL	None	Darkens greatly	Small	1 or more, brushed on and wiped off, to allow penetration. Wipe surface bare		
PENTACHLOR-PHENOL	Wood preservative sometimes used for paneling, particularly in basements, where it is excellent protection against moisture, mildew, and fungus only					

Urheberrechtlich geschütztes Material

Finishes

By Jackson Hand

Here's a factual guide that tells you what finish to use when you want the beauty of wood to show through

of the finish a factor? Or the time you'd spend applying it?

All of these questions interrelate to a degree. Check the chart for quick answers. Read on if you want further help.

The darkening effect. All finishes darken wood—even clear finishes. Some materials have a rather drastic effect. Others add just a whisper of color.

Lacquers darken least. Some special formulas, such as Satinlac lightener, barely change the color at all. These are usually intended only as a first coat and must be topcoated with another clear coat. Although oil-type clears can go over the lightener, lacquer makes more sense since it will have the least darkening effect where you may have put the lightener on a bit thin.

Oil finishes darken most. Boiled linseed darkens most of all. Penetrating resin sealers turn woods quite dark. So do some of the vinyl-alkyd copolymer finishes.

In addition, various materials tend to tone wood colors in individual ways. Oils bring out the reddish hues in wood. Lacquers tend to darken without changing the hue. Shellac brings out yellows.

Much depends on the wood. Dark woods become very dark—whiter woods are affected less. Walnut goes almost chocolate color under oil. White maple barely changes color. If the degree of darkening is critical, it's best to experiment.

Controlling texture. A finish that looks like no finish at all is simple to achieve. You pick one that goes *into* the wood, rather than remaining on top. All finishes do this to a degree, but some are deliberately formulated to penetrate. The old standby, Firzite, is now labeled "Deep Finish." Du Pont frankly calls its penetrating wood finish "Penetrating Wood Finish." Other manufacturers say: "Thin a good interior varnish with turpentine and it becomes a penetrating finish." They are right. One characteristic of the penetrating-type finish is that it is relatively low in solids.

The natural look comes, also, from low-solid finishes that may not penetrate deeply but still have only a small amount of "build." (This is the thickness of the dry film.) Satinlac is in this category. So is shellac, thinned at the rate of about one part of four-pound shellac to two or three parts alcohol. However, since these finishes are not wiped, it may be difficult to achieve an absolutely flat, bare-wood look.

There may be a bit of sheen, unless you treat them with fine steel wool. In addition, when you use a clear material with build, you must work toward a uniform coverage, or there may be mottled gloss—very similar to the mottled color effect that results from an uneven one-coat paint job. Many of us find it difficult to paint uniformly in less than two coats. And you may lose your bare-wood look if its texture is obscured by the build of two or three coats—even with a low-build material.

Again, the kind of wood makes a differ-

CONTINUED

Urheberrechtlich geschütztes Material

ence. Open-pore species such as walnut, mahogany, teak, pecan, chestnut, primavera, and Korina can stand quite a bit of build before their texture disappears, provided you use a low-sheen material. Maple, pine, birch, cherry, and similar close-grained woods lose their texture almost immediately, and are usually best treated with a penetrating wood finish.

How important is protection? On a paneled wall in a living area, a finish doesn't need to be too rugged. On a window frame or around a doorway, perhaps it should be. In a kitchen, where semiannual washing might be in order, you find a middle-degree requirement for protection.

If you need a truly rugged finish, use varnish. Urethane varnishes will take over when protection is the main objective. They are the hardest, the most mar-resistant, the most washable. Their cost is high because they are new, but the price should come down.

For most purposes, a good phenolic or alkyd-resin varnish should be tough enough for most paneling and other woodwork. Even the semigloss or flat types have good wear characteristics.

There is excellent protection, too, in the penetrating finishes, in spite of the fact that they go into the wood, not on its surface. They do not show scratches and abrasions. They provide a surface layer on the wood that is so uniform that it doesn't change color with wear. The main drawback with penetrating finishes is that you may find some staining types of dirt hard to remove.

You can expect the least amount of protection from the nonpenetrating types of finishes which have low-build characteristic.

How to keep the work down. Applying some of the interior clear finishes is the easiest painting there is. The hardest—careful varnishing—is about the same as applying a good coat of enamel.

To apply a penetrating resin finish, you brush the material on any which way (or roll it or swab it with a rag). When it has had 10 minutes to half an hour to penetrate, you wipe off all you can, using rags. This is easy, and requires less care than any other method of painting.

Next month: All about finishes for boats

For similar results with brushing lacquers, you must work more carefully. But they are low in sheen, and tend to hide your ineptness. Semigloss and flat varnishes also will keep it a dark secret if you can't paint. You must be a little careful, however, because these finishes will sag if they are put on too thick.

If you choose a glossy varnish, you must be very careful in your work.

Not all of the time-and-work factor in clear finishes has to do with ease of application. Many of the currently available finishes take two or three coats (read labels carefully). Some require extra-long drying between coats, others *not too long* between coats.

An example is the relatively new vinyl-alkyd copolymer material. A fairly typical label reads:

"If more than one coat is desired, apply the second after one hour but before six hours have passed since the first coat was put on. If this is not possible, wait at least 48 hours."

Why do this? Because the thinner evaporates in 15 minutes or so, and what is left is a dry, but not a cured, film. After an hour it is hard enough so you can brush over it. But after six hours it reaches a stage in curing which is not proper for recoat. Then—48 hours later—you can work on it again.

When you stain large areas. Staining large panels is work—but it can be made easier. Stir a stain into a penetrating resin finish to obtain a mixture that provides a true stain (not a varnish stain) and a finish in one application. Where an extra degree of protection is not necessary, this is a one-coat job. If protection calls for two coats, you can put a second coat of clear (not stain-mixed) penetrating wood finish over the stain coat.

When you want a stain other than normal wood hues, you can make one easily by thinning ordinary alkyd flat wall paint with about equal parts of turpentine. This opens up the entire world of color, for you can pick your flat paint from one of the color systems.

Also, you can save time by using a roller to apply the stain to large areas—since this is a high-tolerance operation. ■■

Urheberrecht ch geschützt Mögl al

Unusual for a rifle, the AR-15 has a hinged barrel that breaks open like a shotgun for easy cleaning and removal of parts. Entire gun can be field-stripped with no special tools other than the point of a cartridge and the rifle's own firing pin.

Now You Can Buy a Hot Combat Rifle for Sport

OUT of the jungles of Vietnam comes a powerful, battle-proven rifle ready for sale to civilians for hunting and target use. It's the Army's rakish AR-15, famed for its success in guerrilla fighting. The sport version is an exact duplicate of the military weapon except for one alteration. Because machine guns are illegal for civilian use, the action is semiautomatic rather than fully automatic. It fires as fast as you can pull the trigger, but won't keep firing if you hold the trigger back.

Originally developed by ArmaLite and now sold by Colt, the jaunty AR-15 looks like a cross between a G-man's submachine gun and something out of Buck Rogers' 25th Century. It has both a pistol grip and conventional butt stock, can be fired from either the waist or shoulder. There's a handy carrying handle on top that doubles as a precision rear peep sight. A flash suppressor on the muzzle is a hangover from military needs.

Highly accurate, the AR-15 sporter fires the hot new .223 Remington cartridge, a soft-point civilian version of the famous full-jacketed 5.56mm military round. The combination of small caliber and high muzzle velocity—3,300 feet per second—gives the .223 Remington the same deadly precision found in high-velocity varmint cartridges. In tests, the gun consistently shoots three-inch or better groups at 100 yards—and that's good shooting.

Weighing only 6¼ pounds, the rifle is light, compact, and easy to handle. It has a 20-inch barrel, is 39 inches overall. Most similar rifles heft over seven pounds and are several inches longer. The magazine holds 20 rounds, but can be reduced to five with a spacer for certain hunting requirements. Price: $189.50. Colt's Firearms, Hartford, Conn.—*Paul Wahl.*

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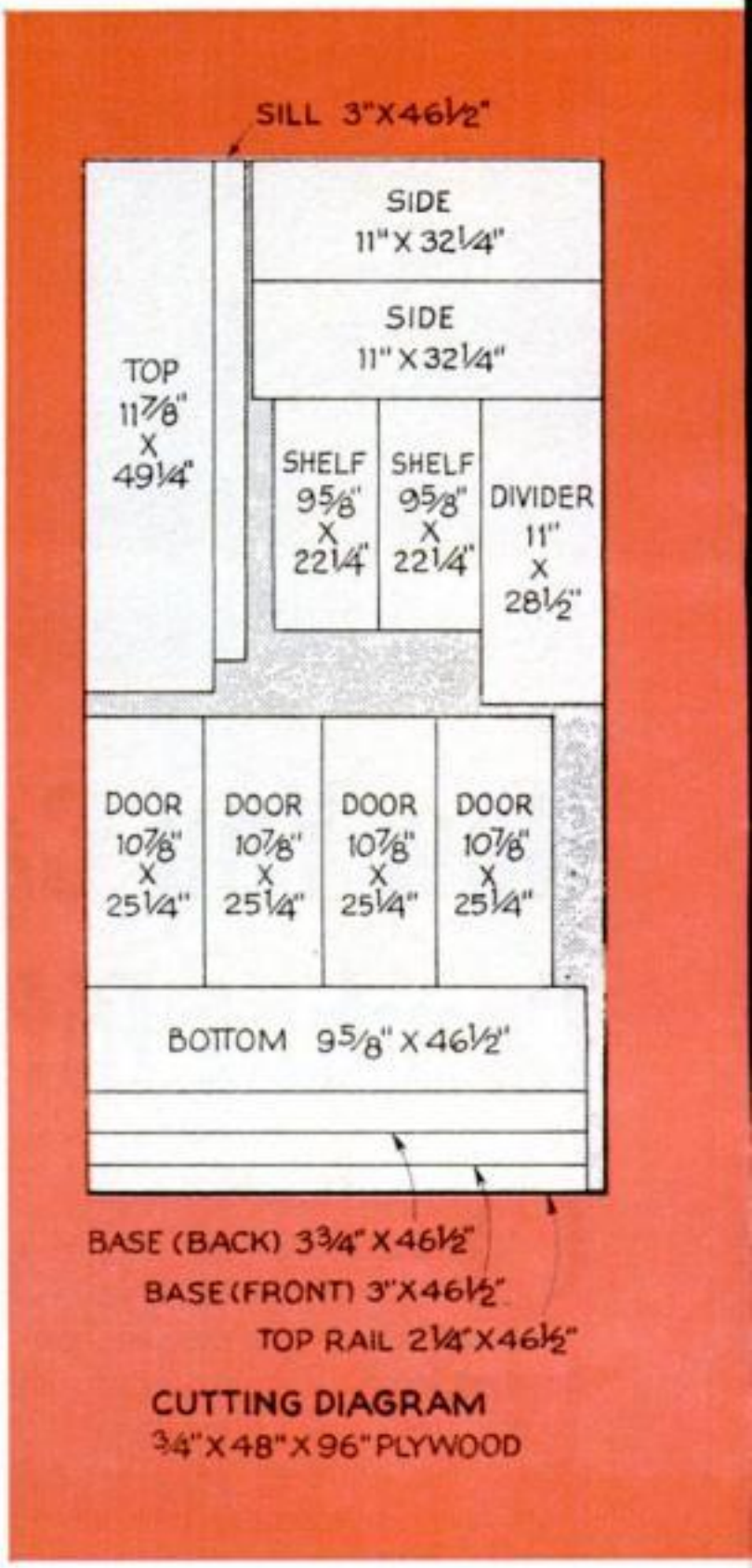

Shallow Cabinet

It projects only a foot from the wall—and you can build it from easily available materials

By Thomas B. Shearer

IS THERE a hall or other narrow area in your home where you can't use a piece of furniture of conventional depth? This shallow cabinet will grace it and give you a lot of useful storage space besides.

The basic parts are cut from one 4′-by-8′ panel of ¾″ birch plywood. All moldings are stock sizes and should be on hand at a local lumberyard.

Drill the two ends and center divider, as shown, for shelf pegs—or use adjustable metal supports. Assemble the bottom first, add the sides, center divider, top rail, and back panel. Check the squareness of the assembly. The back panel can be adjusted to keep the assembly true. Attach eight 1″-by-1″ steel angles inside the upper edges of the assembly so the top can be secured from the inside.

Glue together two pieces of ⅜″ ornamental molding back to back as shown in the drawing to finish off the edges of the cabinet top. Glue and brad ¼″ pine lattice

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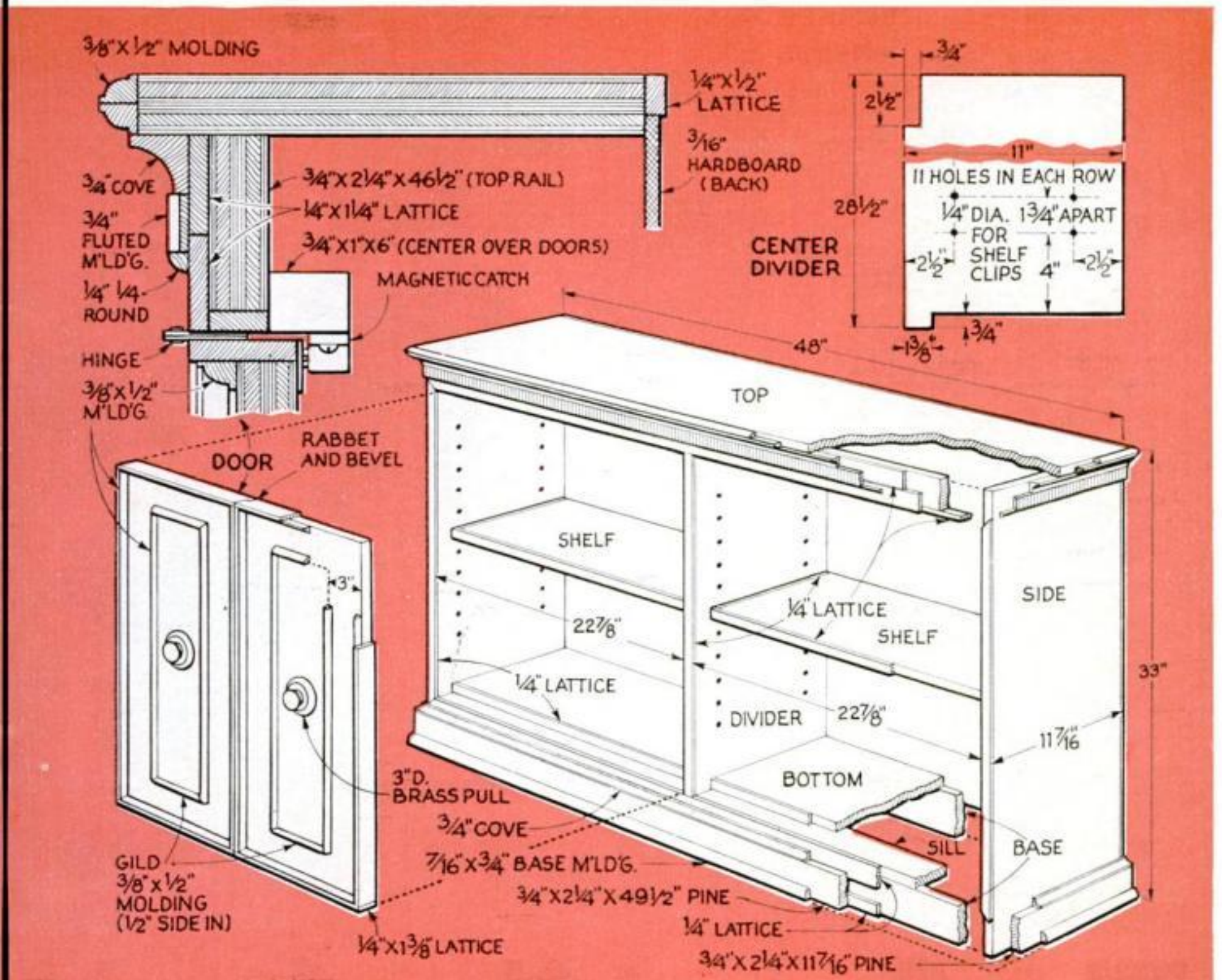

for a Hallway

strips to all other plywood edges. Sand them even with the plywood surface.

The doors are ¾" plywood, edged with ¼"-by-1⅜" lattice strips. Moldings are attached as shown. Pivot hinges are used on door tops and bottoms.

Fill all holes with water putty and sand. Apply a primer and two coats of white enamel. Sand between coats. After the final coat, remove gloss by rubbing with pumice stone and water. Antique with cheesecloth dampened with turpentine and artist's burnt-umber oil paint. Tone intensity can be controlled by the amount of oil color and turpentine used. Door-panel molding is finished in gold.

LIST OF MATERIALS

4′-by-8′ panel ¾" birch plywood
4′-by-8′ panel 3/16" hardboard
6′, ¼"-by-¾" fluted molding
7′, 7/16"-by-¾" base shoe
14′, ¾" cove
60′, ⅜"-by-½" trim molding
7′, ¼" quarter round
7′, ¾"-by-2¼" pine or fir plywood
30′, ¼"-by-¾" pine lattice
32′, ¼"-by1⅜" pine lattice
12′, ¼"-by-1¼" pine lattice
4 pairs hinges
4 brass pulls

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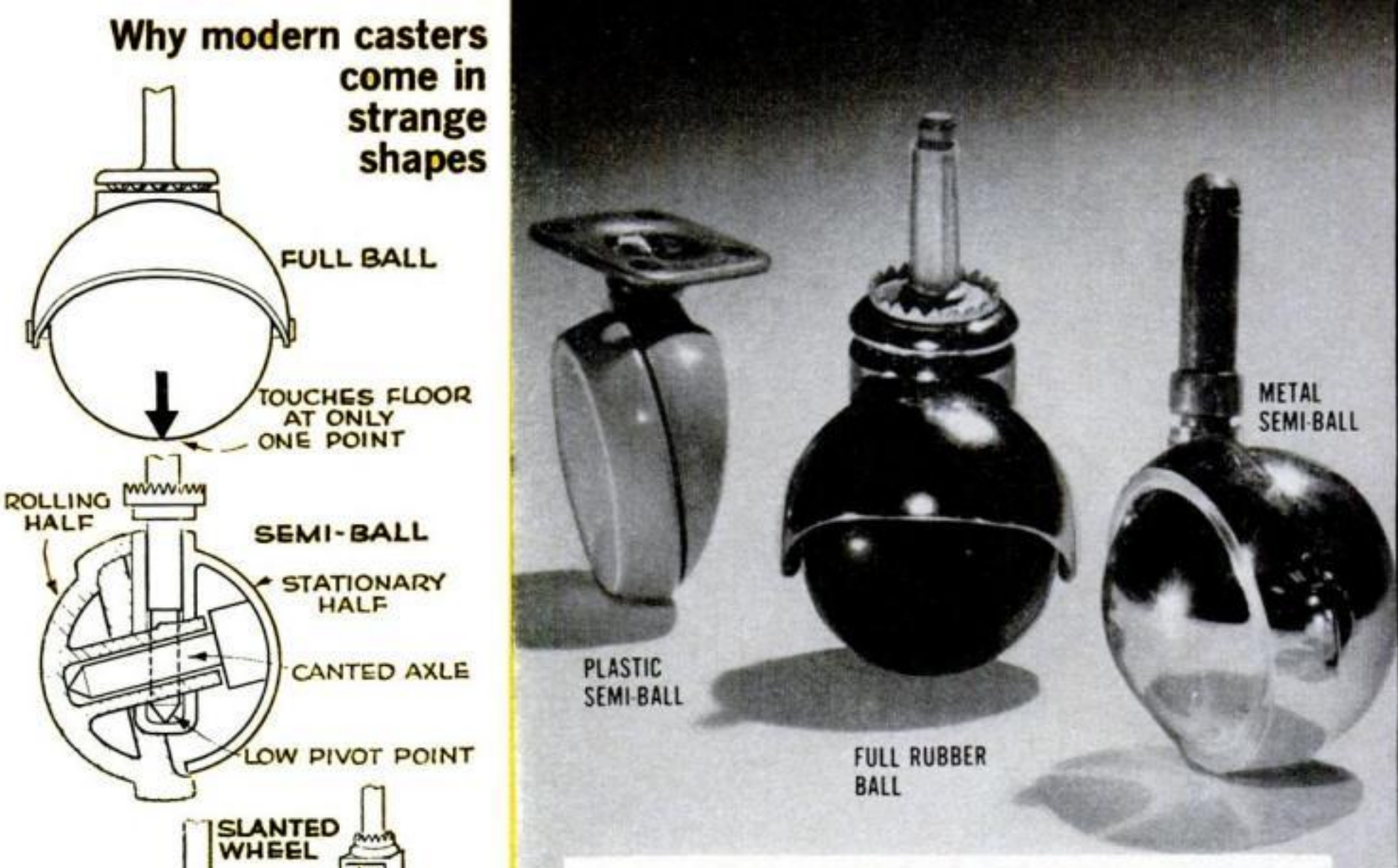

Ball casters, newest to come along, look smarter, roll more smoothly than regular wheels. Full ball cuts down friction. Semi-ball has low pivot for easy, stable castering. Slanted wheel on facing page gets rolling ease of a big caster without its height.

The Smart New Look

For home and shop projects, you now have a bigger, better choice of types than ever before

By George Daniels

IF YOU think of casters merely as squeaky little wheels under a chest of drawers, it's time to take another look. Modern casters come in fancy new shapes and in literally hundreds of types. They look better, work more smoothly, and do more things around your home and shop than ever before.

From a mobile tool stand to a roll-around coffee table, there's scarcely a piece of furniture or equipment that doesn't take on added efficiency, convenience, and good looks when you put it on wheels.

Knowing what type of casters exist and how they work will help you design projects that make the most of these handy wheels. Today's wide variety of mounting arrangements, for instance, makes it easy to attach casters to any type of structure. You can mount them in sockets, on flat plates, or directly on pipe, tubing, or angle iron.

In appearance, there have been changes, too. For sheer elegance, there's a plastic caster that looks like crystal-clear glass. For sheer goofiness, there's a slant-wheel type, called a flying saucer, that looks as if it's falling over but actually rolls better than many upright ones.

But the latest word in casters is the ball.

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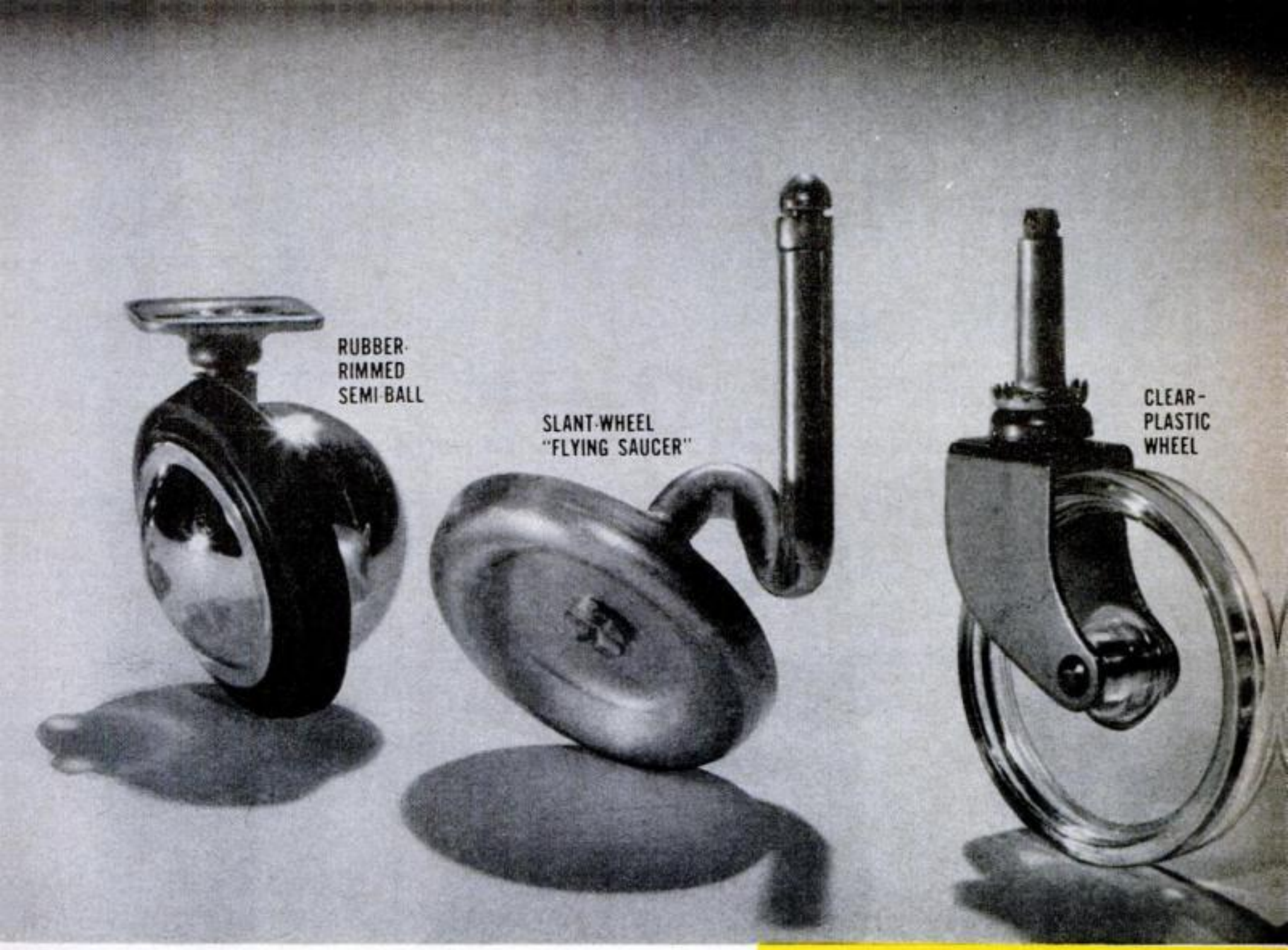

in CASTERS

In addition to its handsome appearance, it involves some clever geometry. In one form, the whole ball turns. Touching the floor at only one point, it has little friction and rolls and swivels easily.

In another version, only half of the ball rotates. The other remains stationary and contains the caster pivot inside. Because the pivot point is below the caster's center of gravity instead of above it, there's no tendency for the wheel to overturn, and its action is smooth and stable.

There are also several types of locking casters. These give you either free-rolling mobility or rigidity. They can be useful for such things as a tool stand that must be stationary while the tool is in use.

Picking the right size. A caster's rated size is determined by its wheel. A 2½" cas-

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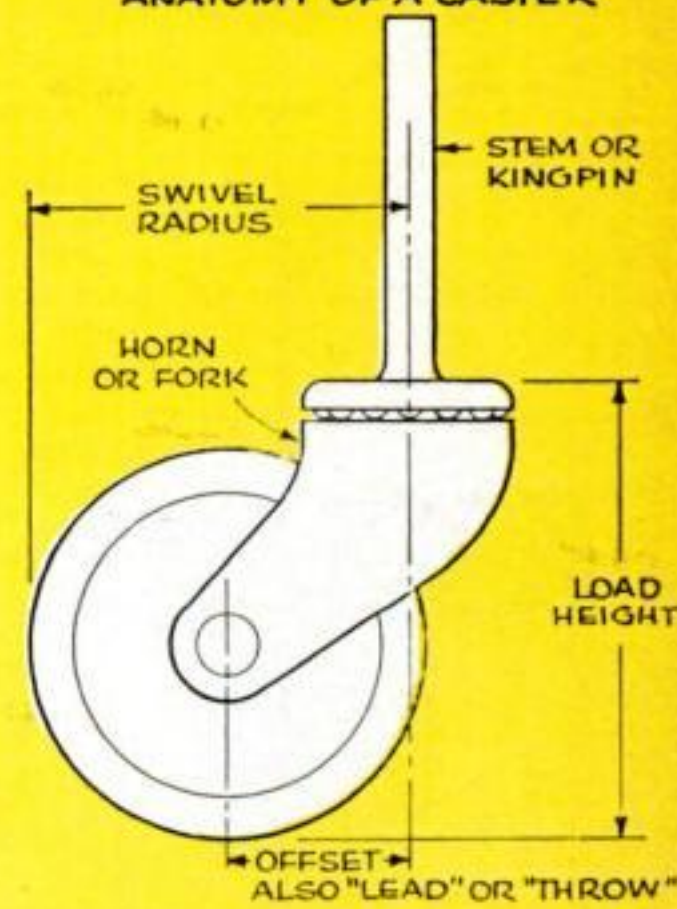

Caster size means wheel diameter, not height. To plan a project, you must know load height. If casters are to be concealed, they must be set back more than swivel radius from the edge. Within reasonable limits, the more offset, the easier a caster swivels.

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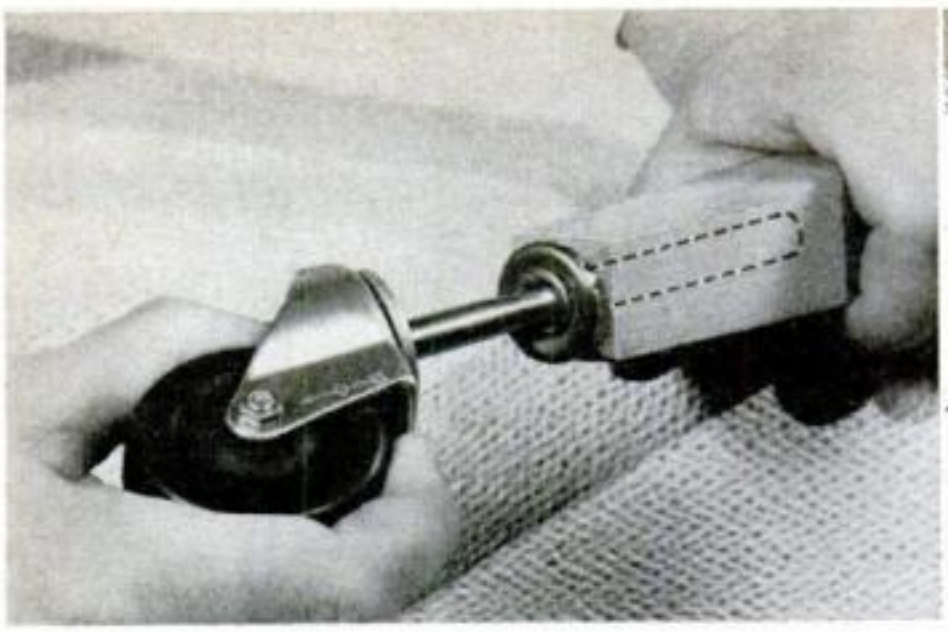
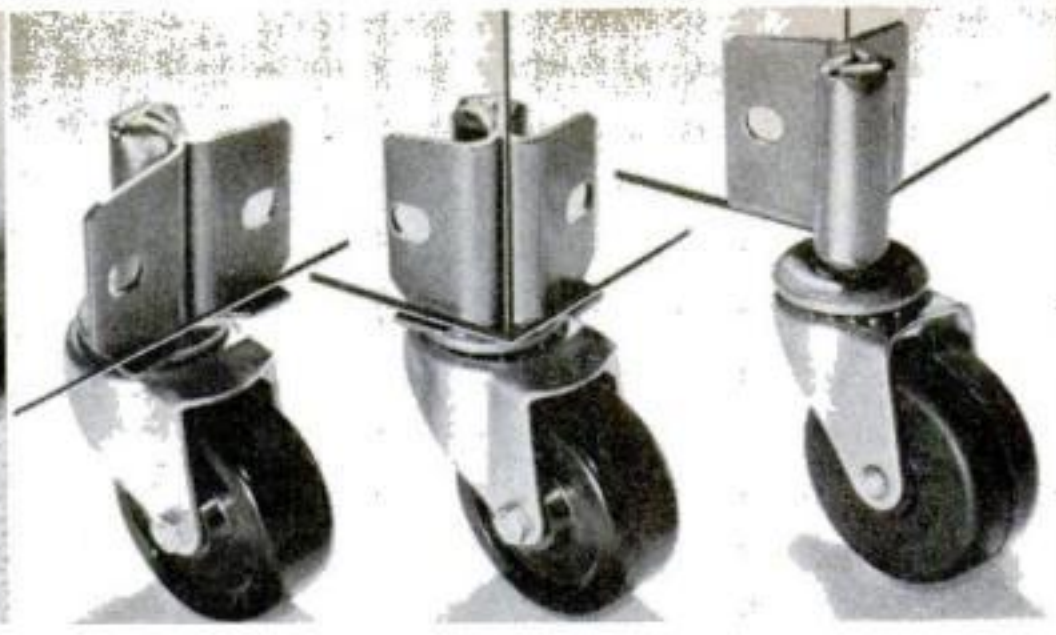


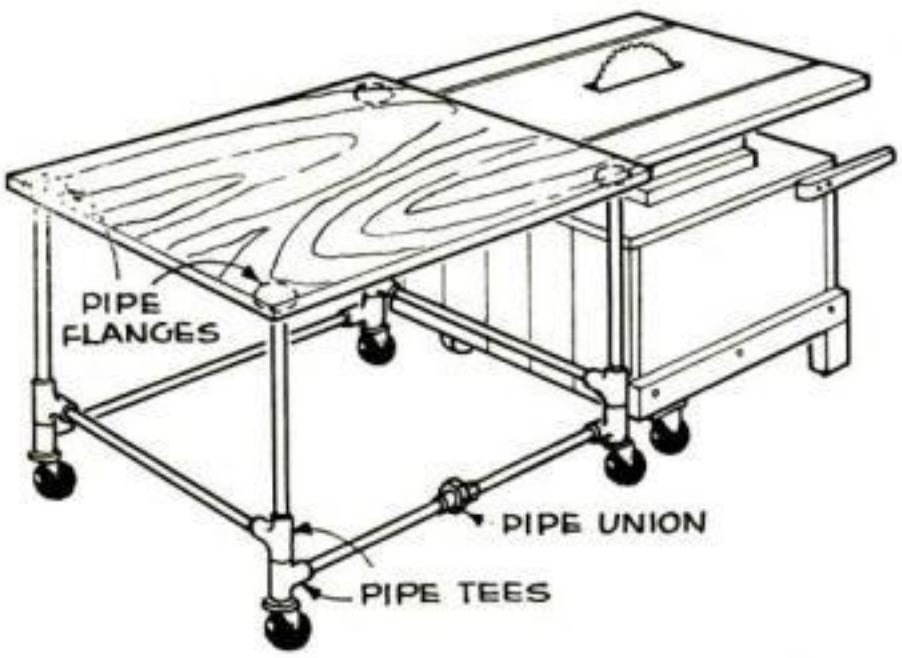


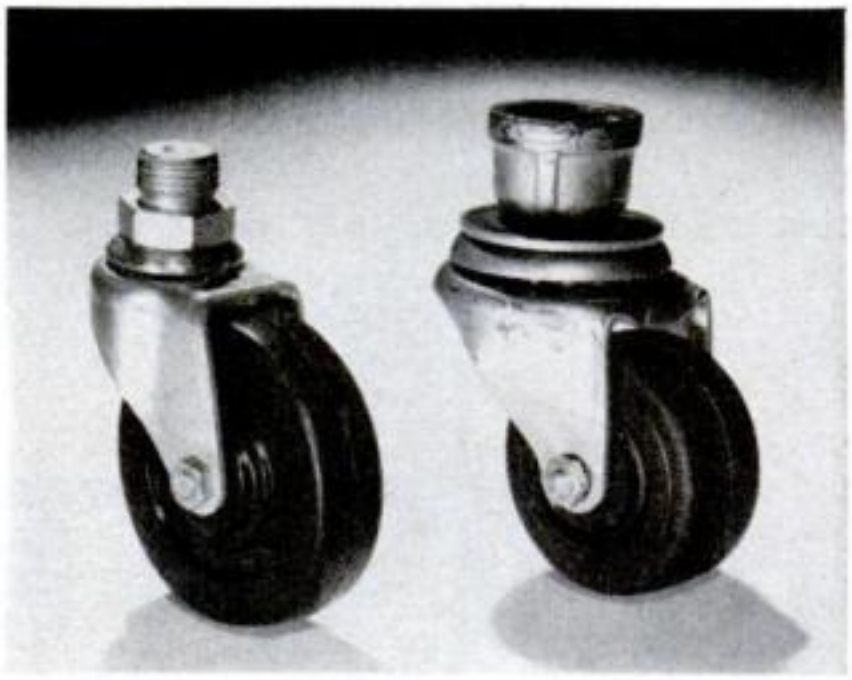
The wide choice in casters can solve many problems of mounting

Conventional stem caster, easily attached, is ideal for slender legs or a base that's thick enough to take the stem. You just drill a hole, push in a metal socket, and slip the stem into it. Advantage: Once the collar is mounted, different casters can be interchanged quickly.

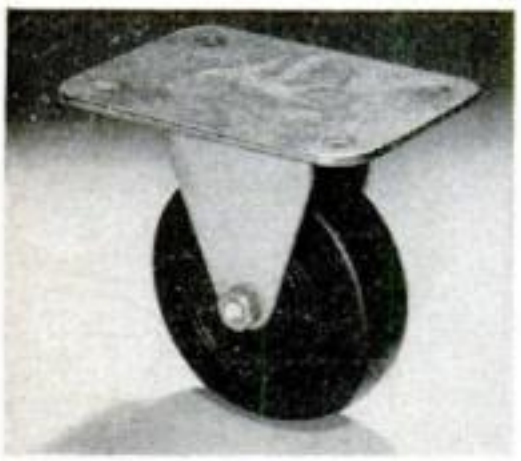
Adapter sockets (above) are made for bolting to metal frames, but can also be used on thin-bottomed chests, especially where there's a skirt. One at left goes inside a skirt or outside a solid chest. Others are corner brackets for use on inside (center) or on the outside (right).

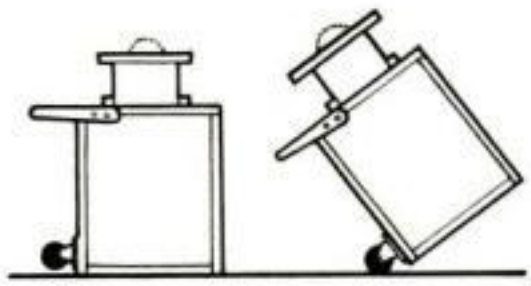
Two kinds of casters that are especially handy for shop use

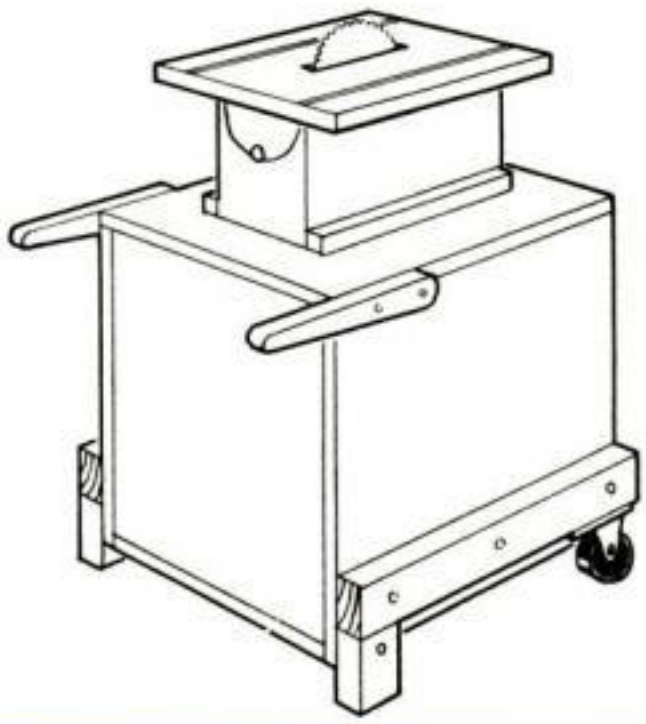




Pipe-thread casters make it easy to add wheels to structures built of pipe, such as tool stands, roll-around work tables, mobile lumber racks. Type at left in the photo has male threads to fit pipe couplings and tees. One at right has female threads for direct connection to pipe. Most common sizes are for ½", ¾", and 1" pipe. You can also get adapter sockets with pipe thread for some regular stem casters.







Fixed casters have no swivel, are useful where you want mainly a straight, stable rolling action, as for heavy tool stands. When used at only one end of a load, they can be steered like a wheelbarrow. Mounted as shown above, they touch the floor only when stand is tipped. Stand at right rolls when lifted, but is rigid at rest.

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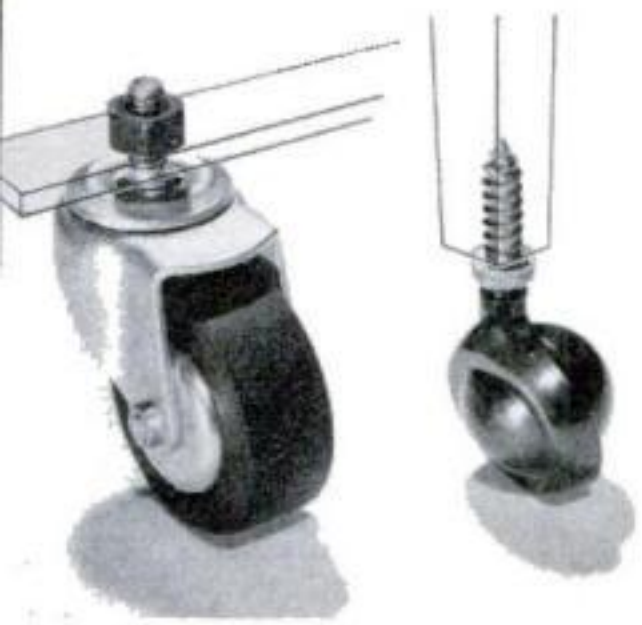
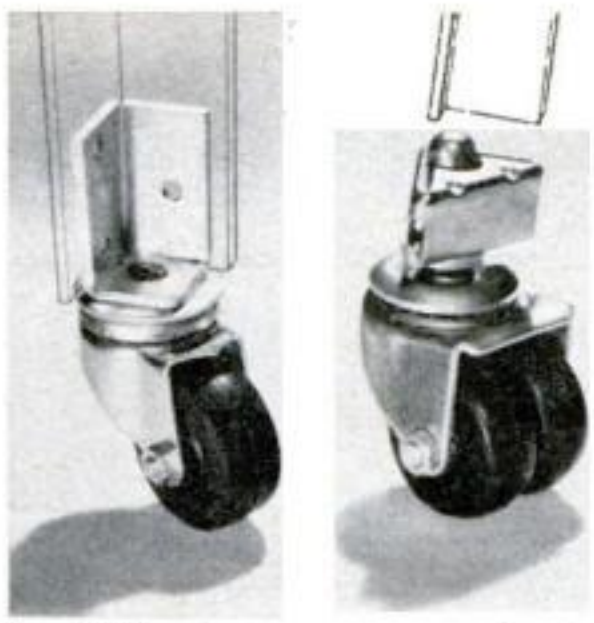
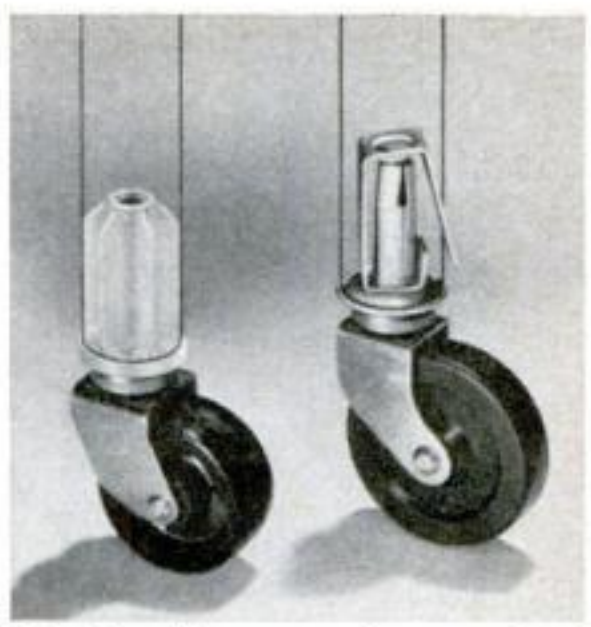


Two threaded casters: Bolt-head caster at left attaches directly to thin wood bottoms or metal frames. It comes in various sizes. Lag-screw stem at right, found mostly on small casters, is the answer where legs are too thin to take the conventional socket and stem.



Angle-bracket casters make it easy to mount wheels on tool stands and other frames made of angle iron. One at left bolts to the inside of an angle-iron leg. One at right has slots that the angle slips into. Most common sizes available are for ¾", 1¼", 1" and 1½" steel angle.



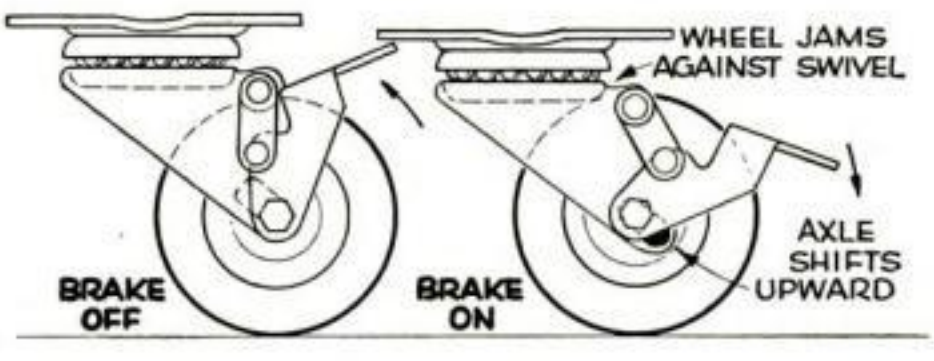
Metal tubing can be attached directly to a caster. The one at left has finned plastic socket that wedges inside a tube's end. The type at right uses a spring clip for grip. Sockets fit regular stem casters, also come for square tubing. They're made in standard tubing sizes.

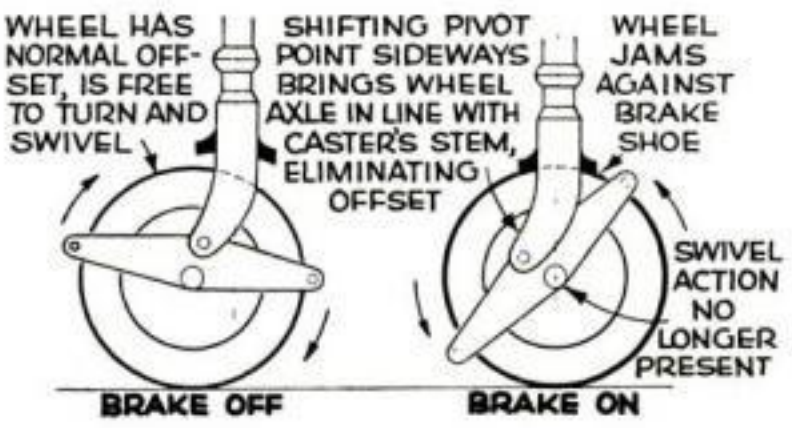
ter means a 2½"-diameter wheel. Its actual height may vary considerably.

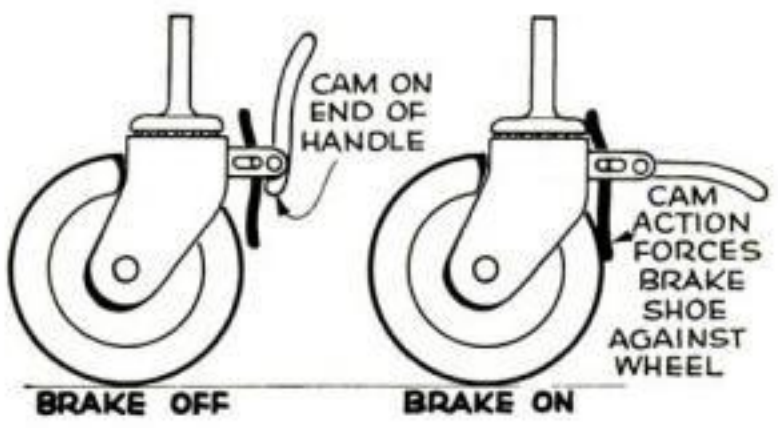
The bigger the wheel, the easier it will roll. You can make this work for you in two ways. Use big wheels on equipment that's heavy or moved frequently. But use small wheels where you want stability more than rolling ease, as on a bureau that's moved only occasionally. Wheels of 1½" diameter or less are adequate for such pieces. For mobile pieces like cribs, tea wagons, and rolling snack bars, use at least 2" wheels on smooth floors, 4" over flagstone, and 5" on lawns.

Locking casters come in several types

Simplest caster brake works by squeezing the wheel hub (upper drawing at left below). This jams the wheel, but leaves swivel free to turn. More complicated design (upper drawing and photo at right) uses a tricky toggle linkage to shift the wheel against the swivel, jamming both at once. In caster at lower left, the wheel is forced against a brake shoe and its pivot joint is shifted so it lines up with the stem, eliminating the caster action. Brake at lower right is powerful, locks both wheel and swivel, is used where a strong lock is important, as on scaffolds.




WHEEL HAS NORMAL OFF-SET, IS FREE TO TURN AND SWIVEL
SHIFTING PIVOT POINT SIDEWAYS BRINGS WHEEL AXLE IN LINE WITH CASTER'S STEM, ELIMINATING OFFSET
WHEEL JAMS AGAINST BRAKE SHOE
SWIVEL ACTION NO LONGER PRESENT
BRAKE OFF
BRAKE ON



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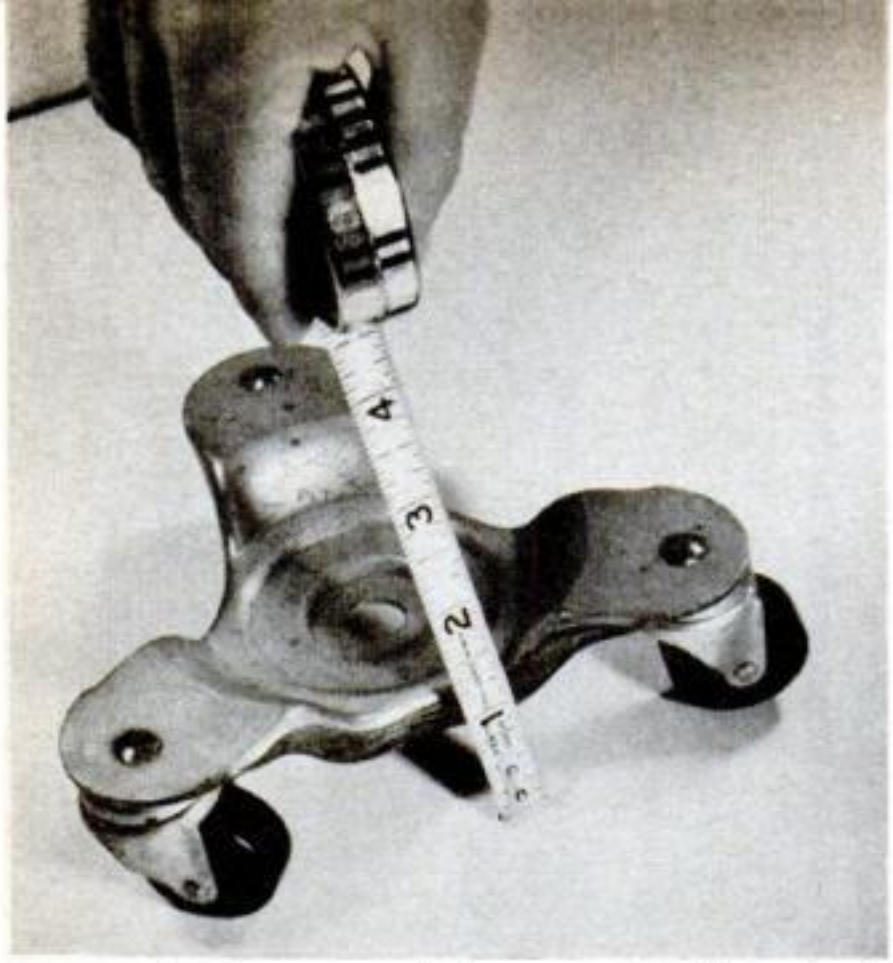
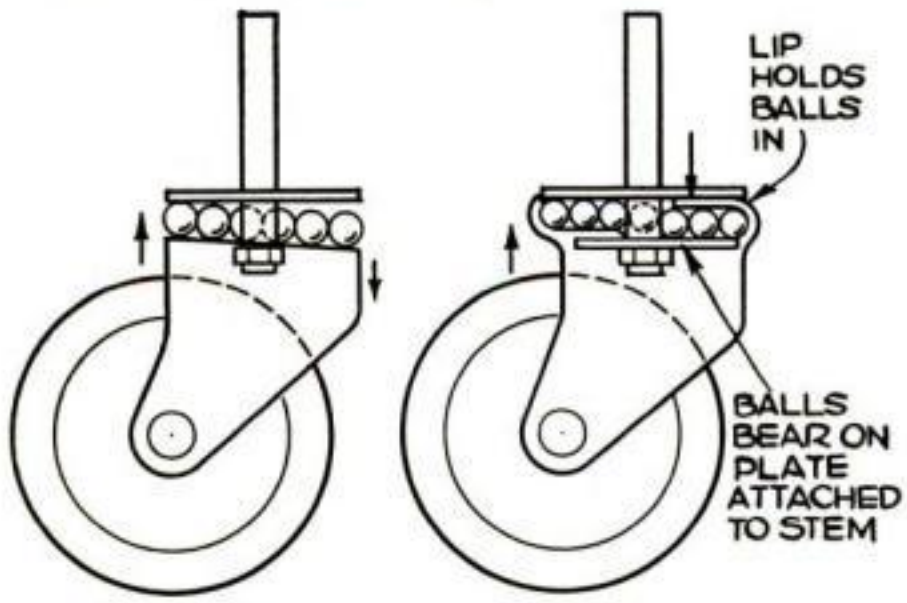
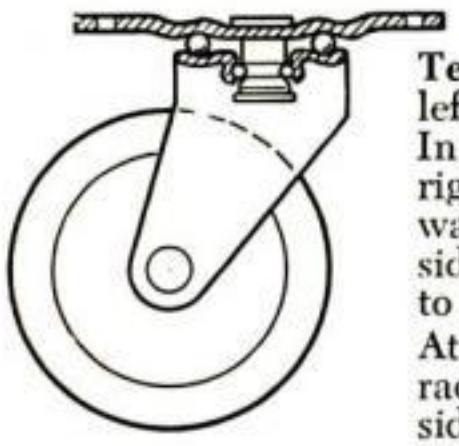


Three-wheel caster dolly spreads big loads over a broad area. Its center is only 1¼" high so it can be slipped under heavy objects without much lifting. It's handy for quick moving of a refrigerator or similar equipment when redecorating. A set of four costs about $6.





Tendency to tip (above, left) is offset in two ways. In split-level bearing at right, balls press downward on the stem on the side away from the work to help push that side up. At lower left, second ball race is added to prevent sideways twist.

Where you want large wheels but can't afford their height, the funny-looking slant-wheel caster is an ingenious answer. It has the rolling ease of a big wheel, but is tipped sideways to reduce its height. It's useful on things like an auto-mechanic's creeper that must be kept low.

How much load will it carry? A caster's rated load capacity is the maximum weight it can carry and still roll and swivel properly. If a maker doesn't list this, you can judge by wheel-tread width. Half-inch wheels are ample for light pieces. For loads above 75 pounds per caster, go to ¾" wheels. For very high loads of 200 to 300 pounds per caster, look for 1" or wider wheels or for doubled wheels.

Choose ball-bearing casters for heavy loads that are moved often. The bearing—which, incidentally, is in the swivel, *not* the wheel axle—allows the caster to align itself more quickly in the direction of motion for easier starting.

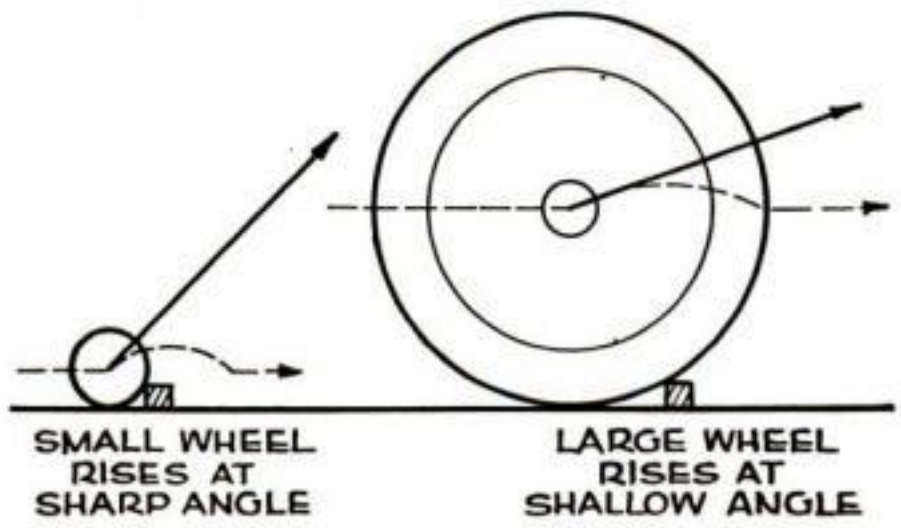
Pick soft-tired casters for use on bare, hard floors. Over carpets, however, choose metal or plastic wheels. These slip easily, while a soft tire tends to catch in a carpet's pile and tear it.

Where to buy casters. Not all of the casters shown here are available off the shelf. Some may have to be ordered from a catalogue, usually available at hardware stores that stock one or more major brands.

Some of the leading caster makers are: **Albion Industries, Inc.,** Thomas Rd., Albion, Mich.; **Bassick Co.,** 3033 Fairfield Ave., Bridgeport, Conn.; **Colson Corp.,** 7 S. Dearborn St., Chicago; **Faultless Caster Corp.,** 1431 N. Garvin St., Evansville, Ind.; **Payson-Harris & Reed, Inc.,** 2920 W. Jackson Blvd., Chicago; **Shepherd Casters, Inc.,** Box 672, Benton Harbor, Mich.; **United States Caster Corp.,** 1630 Oakland St., Kansas City, Mo. ■■

Why big caster wheels roll more smoothly than little ones

Obstructions look bigger to a small wheel because they hit it at a higher point on its rim, force it to climb steeply to get over the top. Large wheel hits same obstructions at a lower point, thus has more leverage to roll up and over. Wheel radius is like the handle on a wrench. The longer it is, the more leverage it has to overcome axle friction. A large wheel rim also spans holes and cracks in floors better and rolls more smoothly over them. Caster action is better, too, on a large wheel because its axle is farther from the swivel's pivot point and exerts greater leverage on it.



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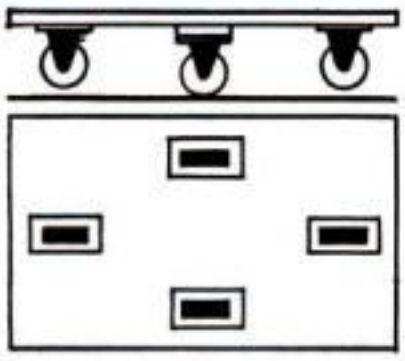
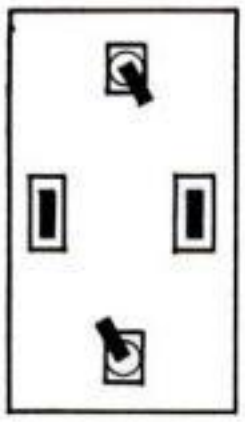
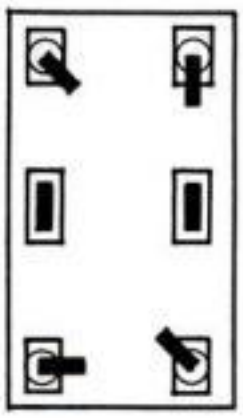
How to pick the best caster arrangements for different kinds of jobs



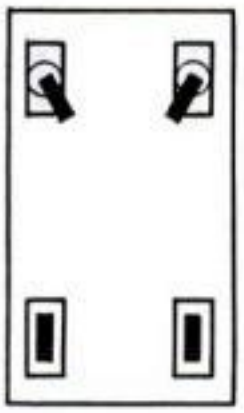
Teeter-totter design has four fixed casters in diamond pattern with center pair raised. It turns on middle wheels while end ones are off the ground. It's good for hand trucks, pipe racks, not tool stands.



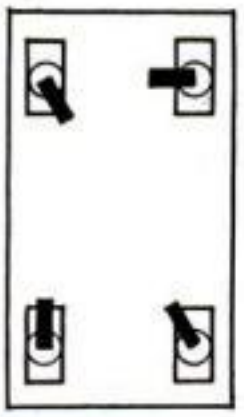
Adding two swivel casters at the ends eliminates need for raising center wheels. Platform rests flat, can make very tight turns. Good for light-duty use in confined spaces. Diamond pattern is not ideal, however, for heavy loads like tools as it tends to be tippy.



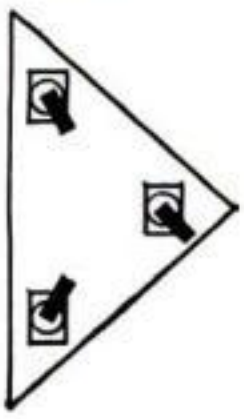
Six casters, two swivel types at each end and a pair of fixed wheels at the center, make a sturdy platform that will support very heavy loads. It's also highly maneuverable. Arrangement is useful for long objects, isn't usually needed for average furniture pieces.



Two swivel casters teamed with a pair of fixed ones are a fine general-purpose arrangement for tools, work tables, furniture. They steer easily, yet follow a straight line well. For straight running, put fixed casters in front; for maximum maneuverability, put swivel ones in front.



Four swivel casters give tops in maneuverability, are fine for tight turns in cramped quarters, but aren't easy to steer in a straight line. Use them on objects that must move in all directions but only a short distance, such as a cocktail table. Not good for tool stands.



Three swivel casters in a triangular pattern make an inexpensive dolly that slips easily under furniture and appliances to move them. The swivels let the dolly move in any direction. Arrangement is best for short-run, temporary use, is not ideal for permanent stands.

All-size pencil holder from one tube

A 2″ to 3″ cardboard mailing tube makes an attractive pencil and brush holder when cut into short sections. Vary the lengths from about 2″ to 5″ depending on the size of the articles to go in them. For an eye-catching effect, paint each tube a different color. Glue the tubes to a wood base.—*J. W. Clement, Healdsburg, Calif.*

►►►Standing on the rungs of a ladder for long periods of time, as when painting a house, can be very painful to your feet. I've solved the problem by cutting inner soles of heavy-gauge sheet metal and slipping them under my shoes' leather inner soles.—*Gerald B. Wardell, Rossford, Ohio.*

Emergency lens hood from a paper cup

Ever been on a picnic or a boat ride and suddenly discover you forgot your camera-lens hood? Here's a simple fix. Cut a hole in the bottom of a short paper cup and slip the cup over the lens. Make the hole a bit smaller than the lens ring so the cup will fit on snugly.—*W. S. Head, El Cajon, Calif.*

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It's a sturdy work top... ***slide-out scrap bin...***

A 4-Way Workbench

A GOOD shop bench should be more than just a work surface. It should also work underneath. The bench you see here was designed to show how wasted space can be put to work in several surprising ways.

Suppose you have a big power tool that takes up a lot of bench space but is needed only now and then. Why not put the tool *under* the bench when it's not in use? We've done it here with a wood lathe because this is one of the biggest tools in any shop and is typically a hard one to store. The same idea can also be applied to other tools, such as a bench grinder, sander, drill stand, or special jigs and fixtures.

The space at the bottom of the bench, normally hard to reach, is put to work with a roll-out unit that's actually two ideas in one. Lift up the hinged top and you have a deep scrap bin for storing odds and ends of lumber. Roll the bin all the way out and you have a low-level work stand that can be moved anywhere you want it. Its open gridwork top lets you do jobs like drilling and sawing that can't be done on a solid top without cutting into it. It's also handy for clamping and gluing.

How the foldaway lathe works. Remember the old-time console sewing machine that popped up out of its cabinet and locked itself in place automatically? The lathe works the same way. The bench top is hinged at the rear and lifts up. The lathe, stored underneath, swings up into operating position on a hinged platform. As it comes up, a hinged flap at the rear hooks automatically under the lip of the platform to lock the lathe in the raised position.

To store the lathe, you raise it slightly so you can lift the flap out of the way,

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roll-around glue and saw bench . . . foldaway wood lathe

You Can Build

By Sheldon M. Gallager

then just swing it back down. A finger hole is drilled at the center of the flap so you can lift it up. A two-by-four handle is bolted to the lathe platform and pivots out from under the lathe bed. This gives you a lever for easy lifting of the lathe.

The bench top is a sturdy sandwich of two layers of ¾" particle board or plywood topped by a layer of ¼" hardboard. It's split lengthwise and hinged so it folds in two. This eliminates any chance that the heavy top might accidentally fall while the lathe is in use and keeps it from interfering with a tool board or overhead cabinet. Folded in two, the top also acts as a screen to keep chips out of the elevating mechanism.

However, while the lathe is being raised and lowered, it's necessary to hold the top up straight, out of the way. For this, run a long hook and eye or a length of light chain or rope from each end of the top to anchor points on the wall. The chain or rope can be fitted with snap catches that hook into screw-eyes.

Planning the drive. The bench shown here was designed around a 12" DeWalt lathe, requiring an overall length of 5'. You can adjust the dimensions to suit the particular tool you plan to use.

If you use a lathe or similar tool that requires a separate motor mount, work out the drive arrangement before settling on final dimensions. The setup shown here incorporates a jackshaft that makes possible a compact motor compartment because the motor and lathe pulleys can be offset. If you don't use a jackshaft, enlarge the motor compartment slightly so the motor can be shifted sideways to align its pulley directly with the lathe pulley.

Mounting the hinges. This is a bit tricky because the hinges for the lathe platform and the rear flap tend to be-

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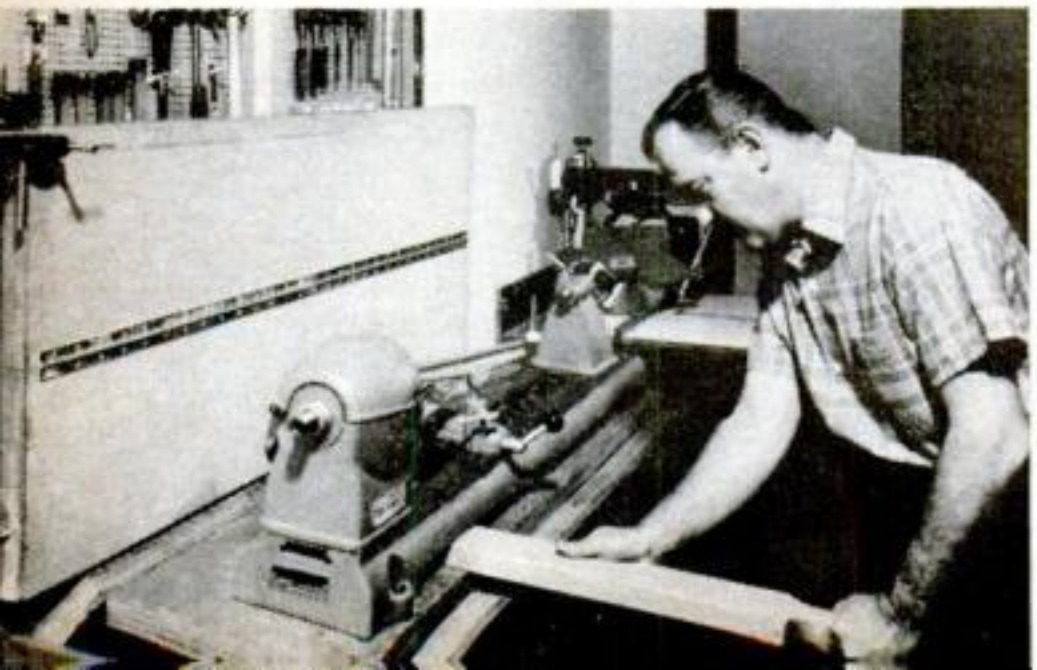
How the lathe pops up

1 Hinged bench top swings up, revealing the lathe stored sideways inside. Note narrow hinged flat at the rear. It can tilt up, but is blocked underneath so it can't tilt down.

2 As the lathe is pulled up on its hinged platform, it pushes up the rear flap and slips past it. The handle, bolted to the lathe platform, gives leverage for easy lifting.

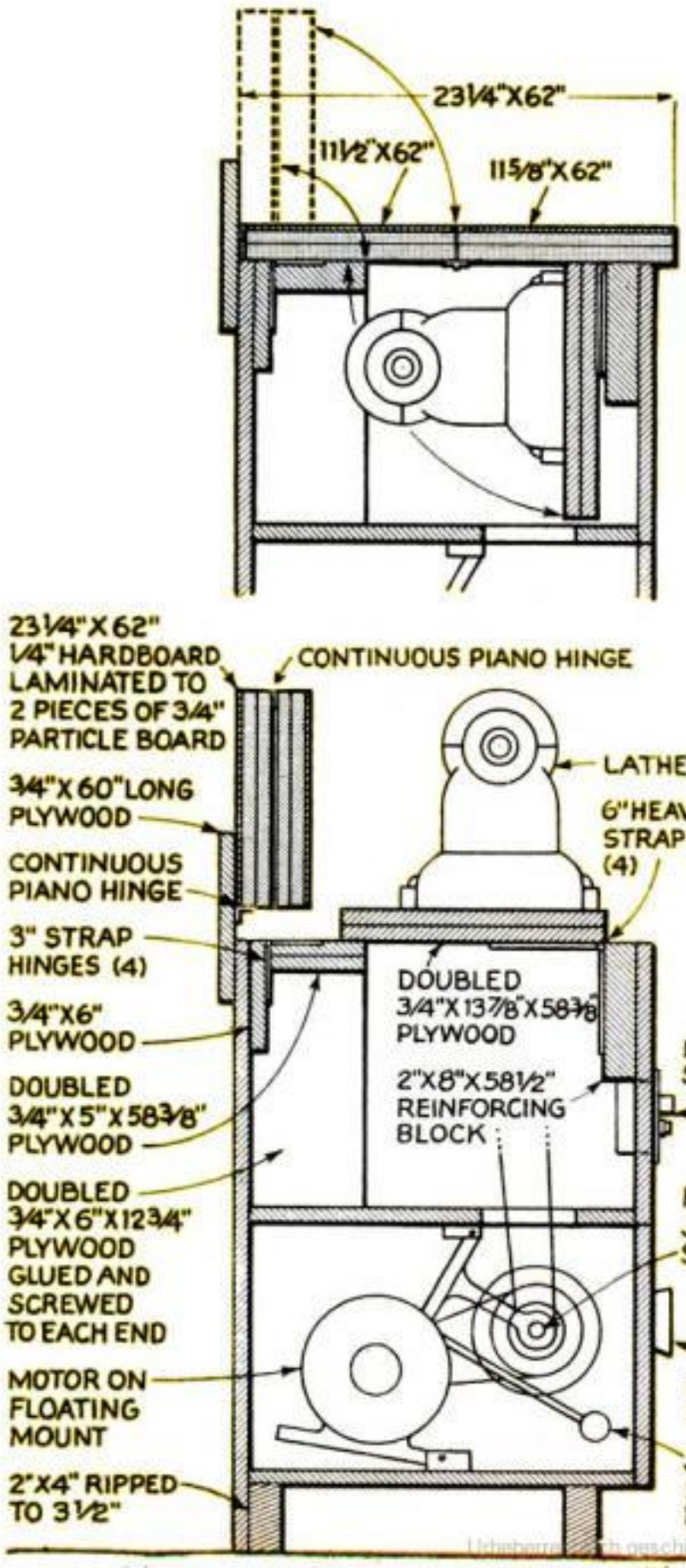
3 Tilting the lathe slightly past horizontal allows the rear flap to slip past it and drop down under its back edge. This locks the lathe in the raised position, ready for use.



come inaccessible as the pieces are placed in position. One solution is to attach the platform and flap to the front and back panels before assembling the bench.

The hinges for the rear flap are made more accessible by using the strap type and running one leaf up and over the top of the flap. This exposes the leaf, but does require that you mortise it flush into the flap. If you'd rather skip the mortising job, use hidden butt hinges, but install them before you assemble the bench.

The scrap bin rolls on four 2½" fixed casters. These are mounted on ⅛"-thick shim pads so the wheels project slightly below the base frame. The base frame on the bin is made of two-by-fours ripped to 3¼" high, while the base for the main bench is of two-by-fours ripped to 3½" high. The ¼" difference provides rolling clearance for the bin. ■■



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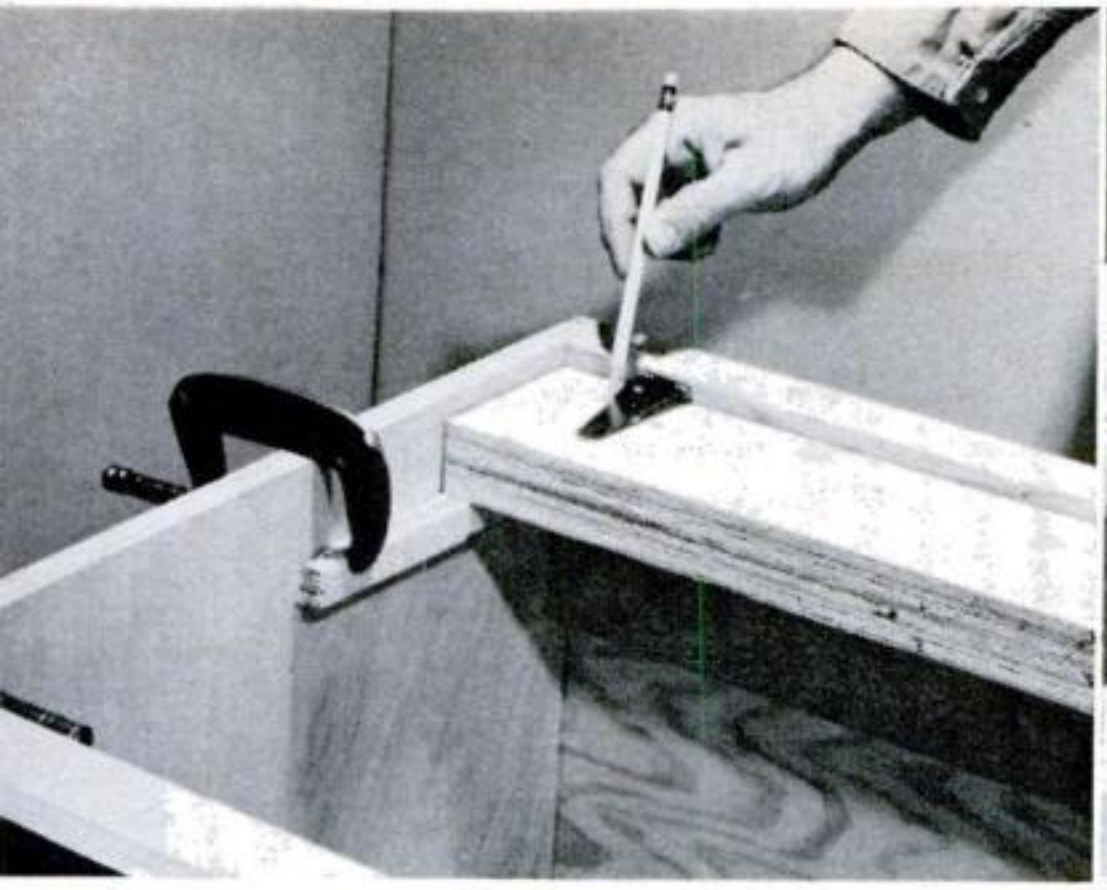
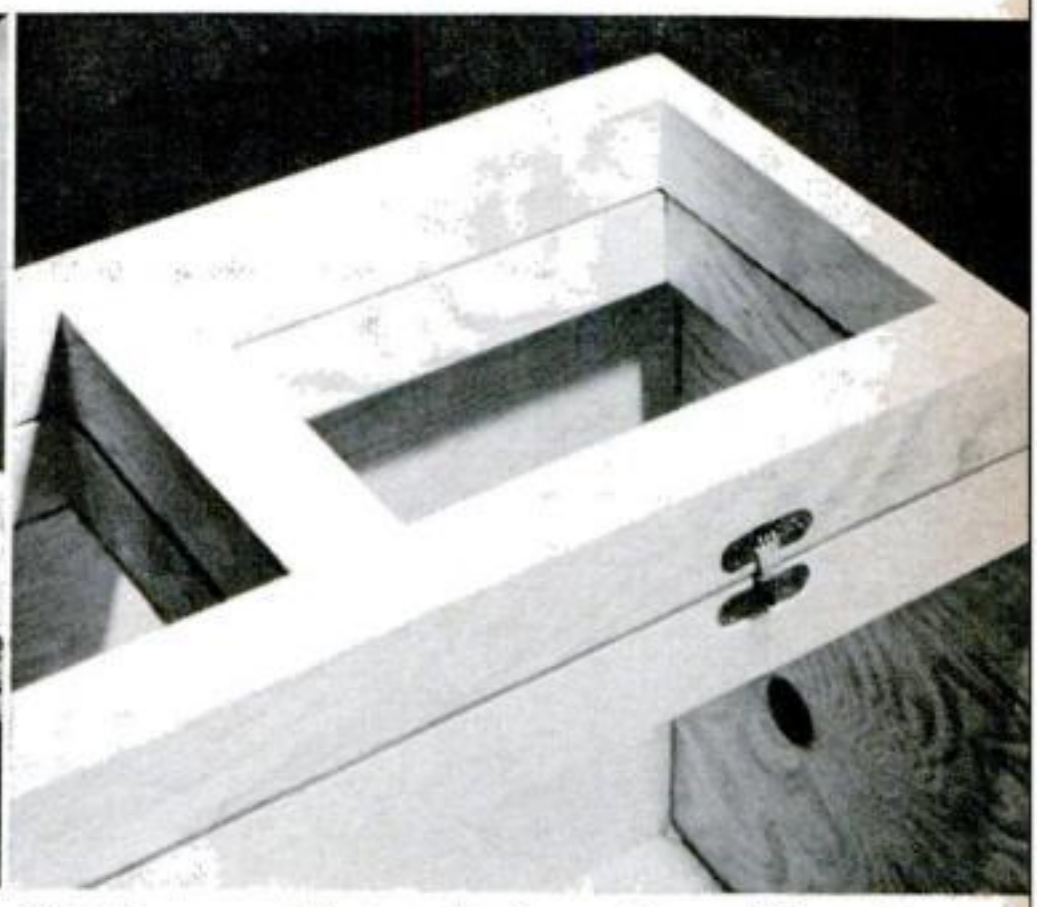
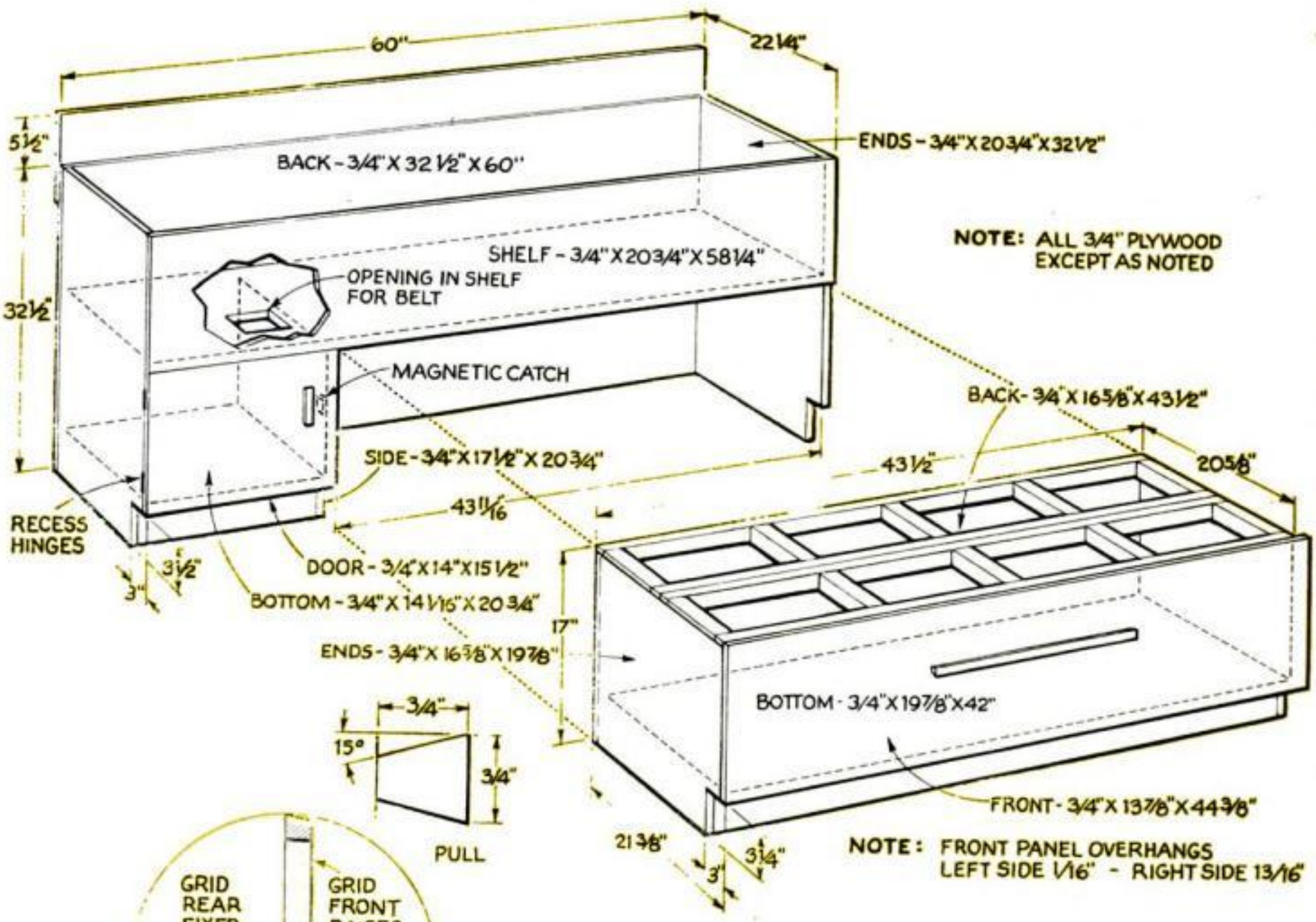


Hinges for rear flap are mounted like this, with upper leaf mortised into the flap. Flap rests temporarily on scrap strip clamped at each end while hinge locations are marked.



Grid for scrap bin is split down the middle and hinged. Invisible hinges used here are slick, but ordinary butts would do. Note how grid is rabbeted at ends to fit inside the bin.



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Gus Breaks Up a Traffic Jam

By Martin Bunn

COMING out of the parts shop with some gaskets, Gus Wilson headed briskly for his Model Garage wrecker at the curb. Snow crunched underfoot. Appreciatively he tasted the crisp, smoke-scented winter air, while eyeing the lively village traffic. Then it happened—in seconds.

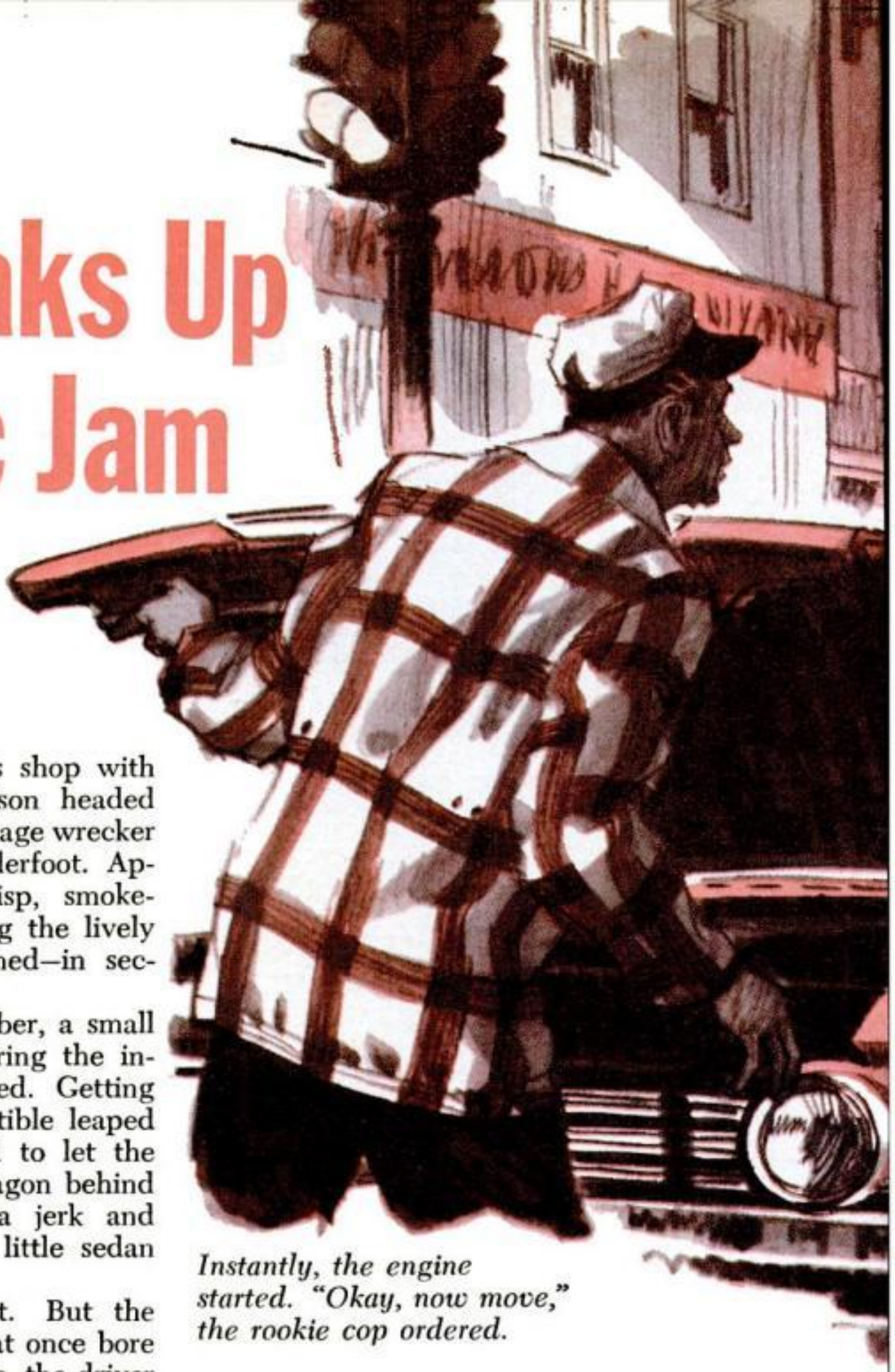
As the cross light turned amber, a small foreign sedan bustled up, entering the intersection on the verge of the red. Getting the main-street green, a convertible leaped away, and immediately braked to let the sedan squeeze by. A station wagon behind the convertible started with a jerk and rammed the convertible. The little sedan scooted out of sight.

It wasn't a serious accident. But the rookie policeman at the corner at once bore down on it. Watching him come, the driver of the convertible planted it firmly in the intersection and emerged with a belligerent air. He was a young man with a square-jawed face that would have done justice to a Roman centurion. The white-haired woman driving the station wagon sat perfectly still.

The rookie cop eyed the back of the convertible and the front of the wagon appraisingly. "Doesn't seem to be any damage," he said. "Better move on."

Growling in his throat, the young man got back into his car. Its starter whirred, the tiger tail on its whip antenna quivering in response. The engine fired, but as quickly died. Jaw set, the driver turned the key again, with the same result.

"Come on," urged the rookie. "You're blocking traffic." He waved an angry hand.



Instantly, the engine started. "Okay, now move," the rookie cop ordered.

Again the starter ground. There was an explosive response, but the engine didn't catch. The driver looked back at the wagon.

"How about a push?" he yelled.

"You willing to push him, lady?" asked the rookie. "I'll hold traffic for you."

The woman sat up straighter, but shook her head. Gus tossed the gaskets into the wrecker and approached the convertible.

"She stalled when I slammed on the brakes," said the driver. "But it'll run if I can get a fast push."

"Mind if I try something?" asked Gus.

"Be my guest," the man replied moodily.

Gus opened the hood. The trouble could be anything from fuel failure to a bad coil.

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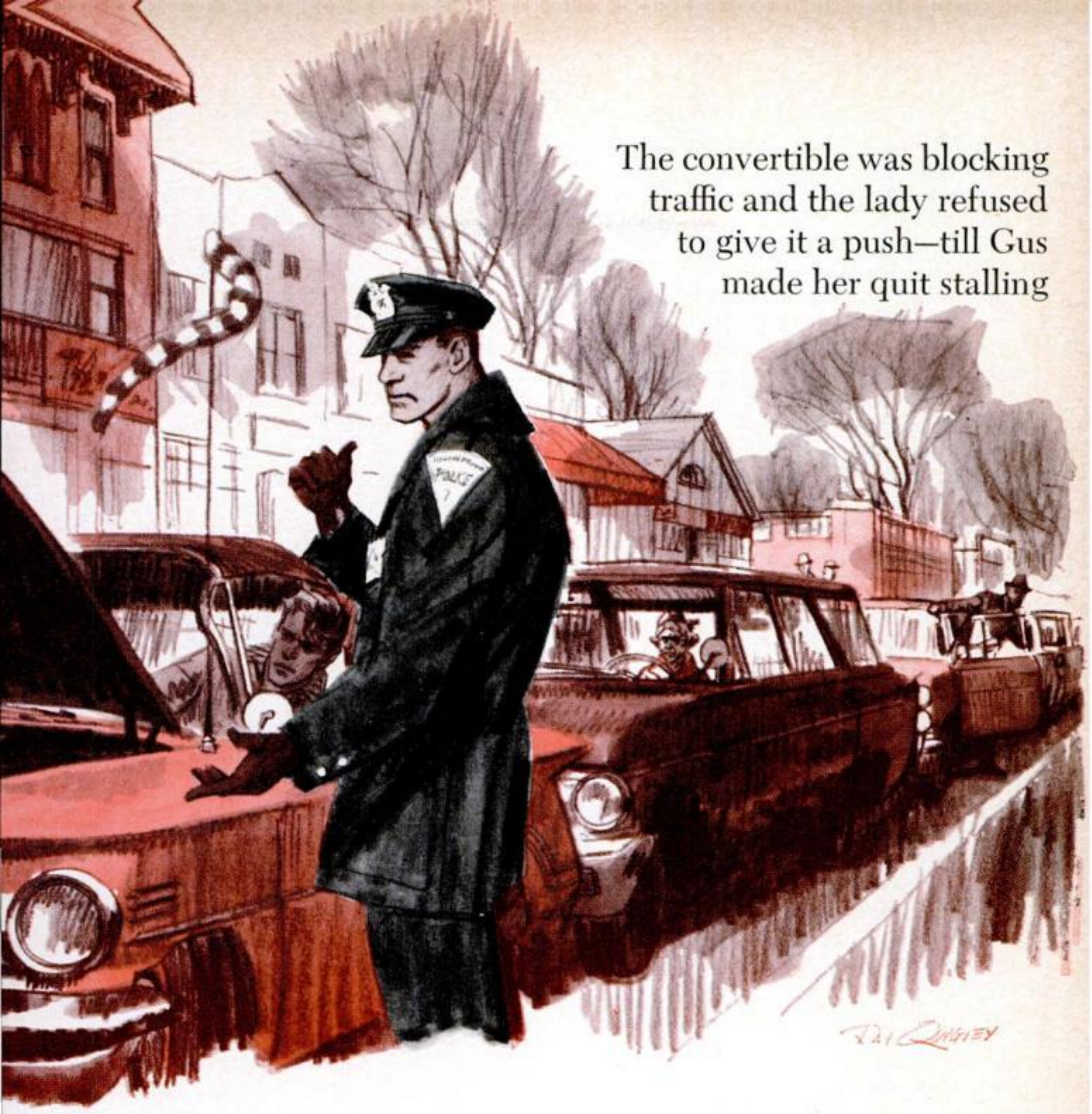
The convertible was blocking traffic and the lady refused to give it a push—till Gus made her quit stalling
POLICE
DAI RIGLEY

Playing a hunch, he disconnected the vacuum line to the spark advance and shut its open end with a finger.

"Okay, crank it now," he called.

The driver turned the key. Instantly the engine was running. Gus slipped the vacuum line back on and closed the hood.

"Hey, what'd you do?" demanded the driver. "I been havin' a hard time—"

"Okay, break it up," ordered the rookie ungraciously. "Now move."

The convertible moved.

With ponderous dignity, the policeman walked back to the station wagon.

"You, too, ma'am. Go ahead."

"No, indeed!" said the woman firmly.

She was so small that her head scarcely rose above the wheel. Her blunt refusal was as surprising as a bark from a kitten.

"Huh? Why not?" demanded the rookie.

"I've just come from a service station because my engine was stalling. They *did* something. Now it doesn't stall, but every time I put it in Drive the car almost gets away from me. This is my very first accident, and I will *not* drive the car another block in this condition."

With traffic detouring around the wagon, the rookie looked appealingly at Gus.

"Just start the engine?" asked Gus.

It roared into action as he raised the hood—and kept on roaring, at far too fast an idle for an automatic drive. The fast-idle cam was backed off normally, but somebody had set up the idling adjustment

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Urheberrechtlich geschütztes Material

too far. With his pocket screwdriver Gus reset it until the engine idled sensibly, then closed the hood.

"It won't jump forward now," he told the woman. "But it may stall again at times. If it does, have an agency or garage check it. No, there's no charge," Gus added as she produced an enormous pocketbook.

"That's very kind of you," she said. "I'm only here on a visit, so I didn't have a garageman—until now. I fancy I can find you where it says on your truck."

Gus nodded. The woman flipped down a lever and the wagon slid smoothly away.

"Thanks, Mr. Wilson," said the rookie.

Gus made one more stop before returning to the Model Garage. Standing by the door was the tiger-tail convertible. Its driver stopped pacing to stamp out a cigarette.

"My name's Joe Murch," he said as Gus alighted. "You must be Gus Wilson."

"That's right." Gus glanced at the convertible, now running at a fast idle and roughly.

"That cop never gave me time to ask—I gotta know what you did back there. This mill has been starting hard for a couple of days."

Gus shrugged. "The way it sounded when it tried to start, I'd say that your timing was overadvanced. Firing too far ahead of top dead center, the pistons were kicking back. You know why you disconnect the vacuum advance when you use a timing light?"

"Yeah. To make sure there's no vacuum on the diaphragm that advances the spark."

"That's right," said Gus. "So I disconnected the line, figuring that might drop the timing back a hair—just enough to get you started."

The young man frowned. "I power-timed it a week ago. Borrowed a timing light to set it 12 degrees before top dead center, and got me a few extra horses. But it started okay, until yesterday."

"Maybe something advanced it more," suggested Gus.

"Like what? I tightened the distributor real good." Murch threw up the hood, grasped the distributor and twisted it with all his strength. "See that? It's still tight. I haven't touched a thing since but the points."

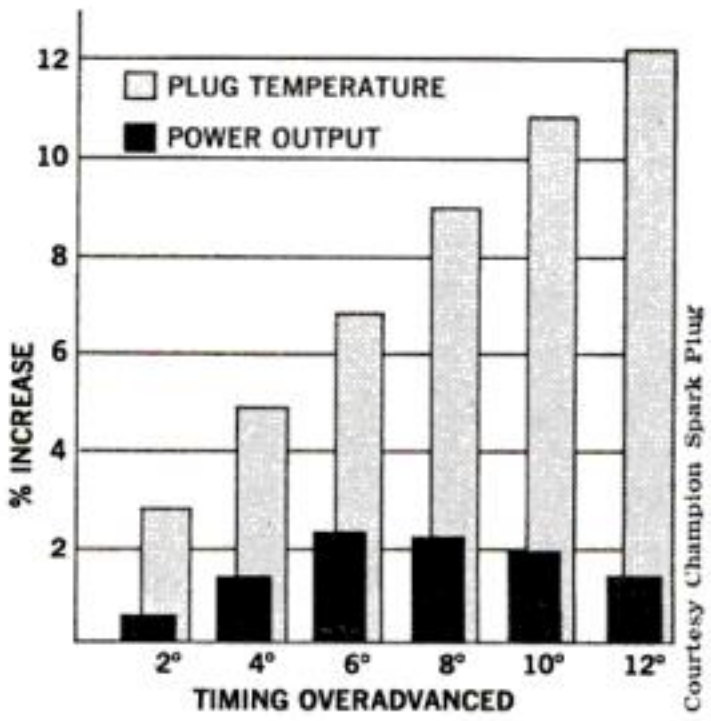
Gus grinned. "When? Yesterday?"

"Yeah. So what?"

"Better borrow that timing light again," advised Gus. "I'd almost bet you'll find the timing ahead of where you set it."

Murch stared at him. "It's a bet! You check it. If it's more than 12 degrees ahead, I pay you to reset it. If not, no charge."

"Guess I walked into that," said Gus.



What happens when you power-time is shown graphically on this chart, made from dynamometer tests. Maximum power gain is two percent, with six degrees overadvance. Beyond that, the power falls off again, while the temperature of the plugs (and detonation) climb destructively.

Before Gus could enter the shop a station wagon rolled briskly up the apron—the same wagon that had nudged Murch.

"It was easy to find you, Mr. Wilson," called the driver. "Everybody knows you. I am Mrs. Leonard Phipps."

"Still having trouble, Mrs. Phipps?"

"It's stalling again, as you said it might. I do hope you can stop that."

"If you'll wait—" began Gus, knowing his helper Stan had a rush job to finish.

"Aw, go ahead," interrupted Murch. "I can wait, especially since it's going to be free."

Mrs. Phipps drove in. Hooking up his tachometer, Gus set the idle at the recommended r.p.m. figure for her automatic-transmission car. Then he gunned the engine briefly and let the throttle snap shut.

The engine promptly stalled.

Disconnecting the tach, Gus hooked the two alligator clamps of a portable oscilloscope to the battery, clipped a sleeve terminal on the center distributor cable and another to a plug cable.

With the engine running again, he watched the hooded face of the scope tube as six luminous traces rose to varying heights from a base line. Gus opened the throttle suddenly, revving up the engine. Even under the higher compression of sudden acceleration, things looked good. The traces

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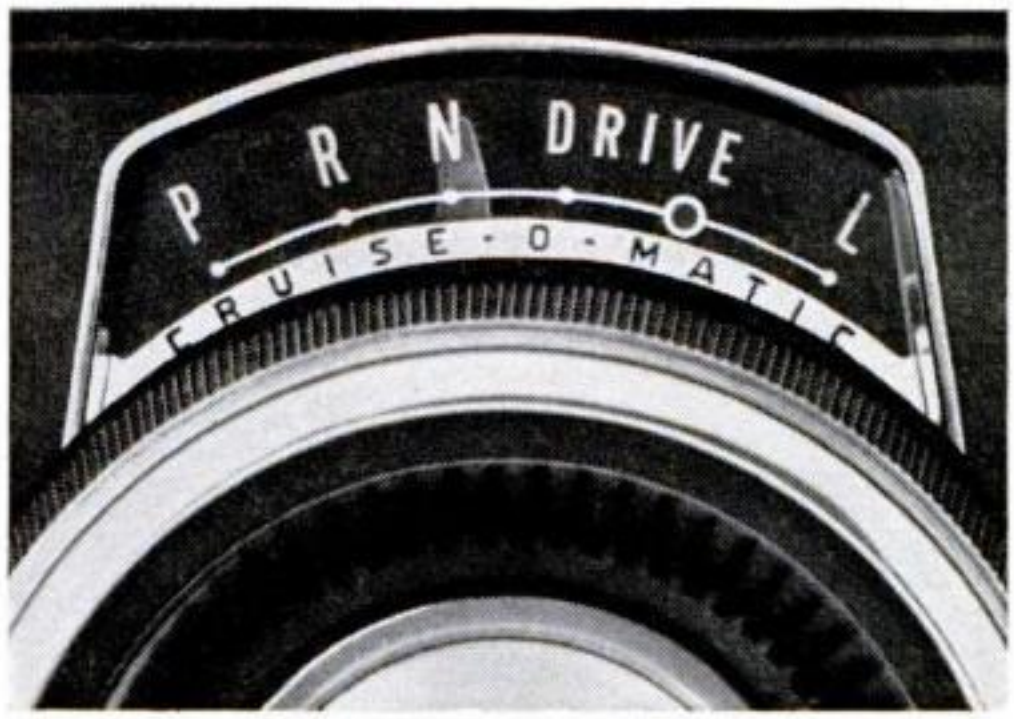

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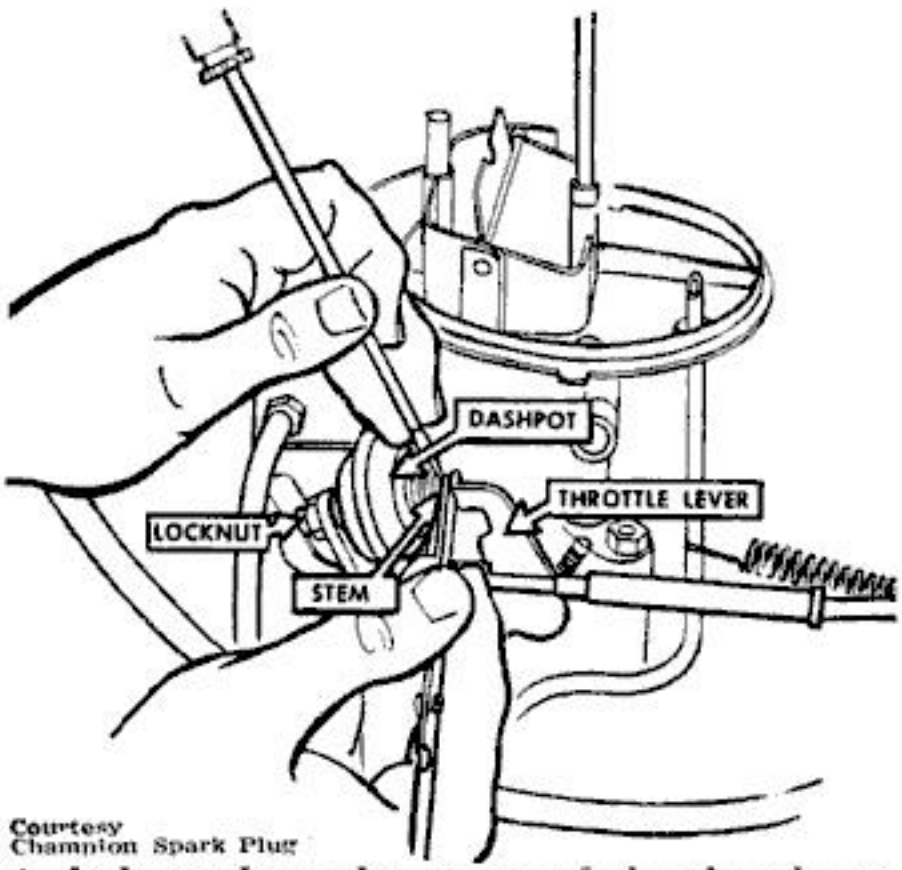


Courtesy Champion Spark Plug

A dashpot slows the return of the throttle on some automatic-drive cars to prevent engine stalling. With the dashpot stem depressed, clearance between it and the lip of the throttle lever should be between 1/32" and 3/8".

remained below the level red-lined for excessive voltage, indicating no worn or too widely gapped plug. Nor was any trace significantly short, signaling a fouled one.

Detaching the instrument, Gus gunned the engine again and watched the throttle lever snap back. The engine gasped but kept running. Once more Gus opened and suddenly released the throttle. As it snapped shut, the engine stalled.

The young man watched skeptically as Gus pushed back the end of what resembled a vacuum-diaphragm housing. "What's that?"

"A dashpot," replied Gus, eyeing the quarter-inch gap between the depressed stem of the unit and the throttle-lever lip. Loosening a locknut, he screwed out the dashpot until the clearance was less than an eighth.

"You find dashpots on some automatic-drive cars," he went on. "They slow throttle closing, so the engine won't stall at the low idle you need to prevent creeping. This one was out of adjustment."

Restarting the engine, Gus again opened and suddenly released the throttle. It hit the dashpot stem, was slowed, and closed with feather softness. Gus got into the car, put it in Drive, and, holding the brake on, repeated the test several times.

"It's okay now, Mrs. Phipps."

"Fine. But this time," she said firmly, "I insist on paying. And no argument."

Gus didn't argue.

Murch drove his car in as the wagon rolled out. Gus unhooked and plugged the vacuum-advance line, then hooked up his tachometer and set the throttle at 850 r.p.m., the correct speed for timing the convertible's engine. He connected the timing light and in its flash read the chalk-whitened marks on the crankshaft damper. The pointer was well past the 10-degree mark.

"I never set it that far ahead."

"It's nearer 14 than 12, that's sure. But 5 degrees is right, not 12. Now, wait," said Gus as Murch started to protest. "Of course timing makes a big difference in power—if it's 5 degrees late, you can lose 35 horses in a 200-horse engine. But you fellows who power-time are kidding yourselves. Know how much extra you get if timing is overadvanced seven degrees? Two percent!

"But with seven degrees overadvance, plug temperatures climb eight percent. Cylinder temperatures go up, too. You may not hear any detonation knock, but it's slamming around the guts of your engine, punishing pistons, rods, and valves. Any time you buy gas a few octanes lower, detonation gets worse. Ditto as carbon builds up."

"You win," mumbled Murch. "Set it back. But what moved it up?"

Stopping the engine, Gus took off the distributor head. "Yesterday you adjusted the point gap—wider. Right?"

"Sure. How could that advance timing?"

"Increasing the gap is the same as decreasing the dwell angle—the length of arc in which the cam leaves the points closed. That means the cam breaks the contacts a little earlier in its rotation."

Gus checked the point setting. "The gap is all right. But it was smaller when you set the timing. When you increased the gap, the effect was to advance the timing. Any time you adjust points, the timing should be checked *afterwards.*"

Gus started the engine and carefully set the distributor to line up the timing pointer at the center mark. With the vacuum line reconnected, he adjusted the idle. When the engine was revved up, the timing mark crept up smoothly.

"That's how I'd set my own car," said Gus, unhooking the light. "Regular tune-ups will do more for you than power timing."

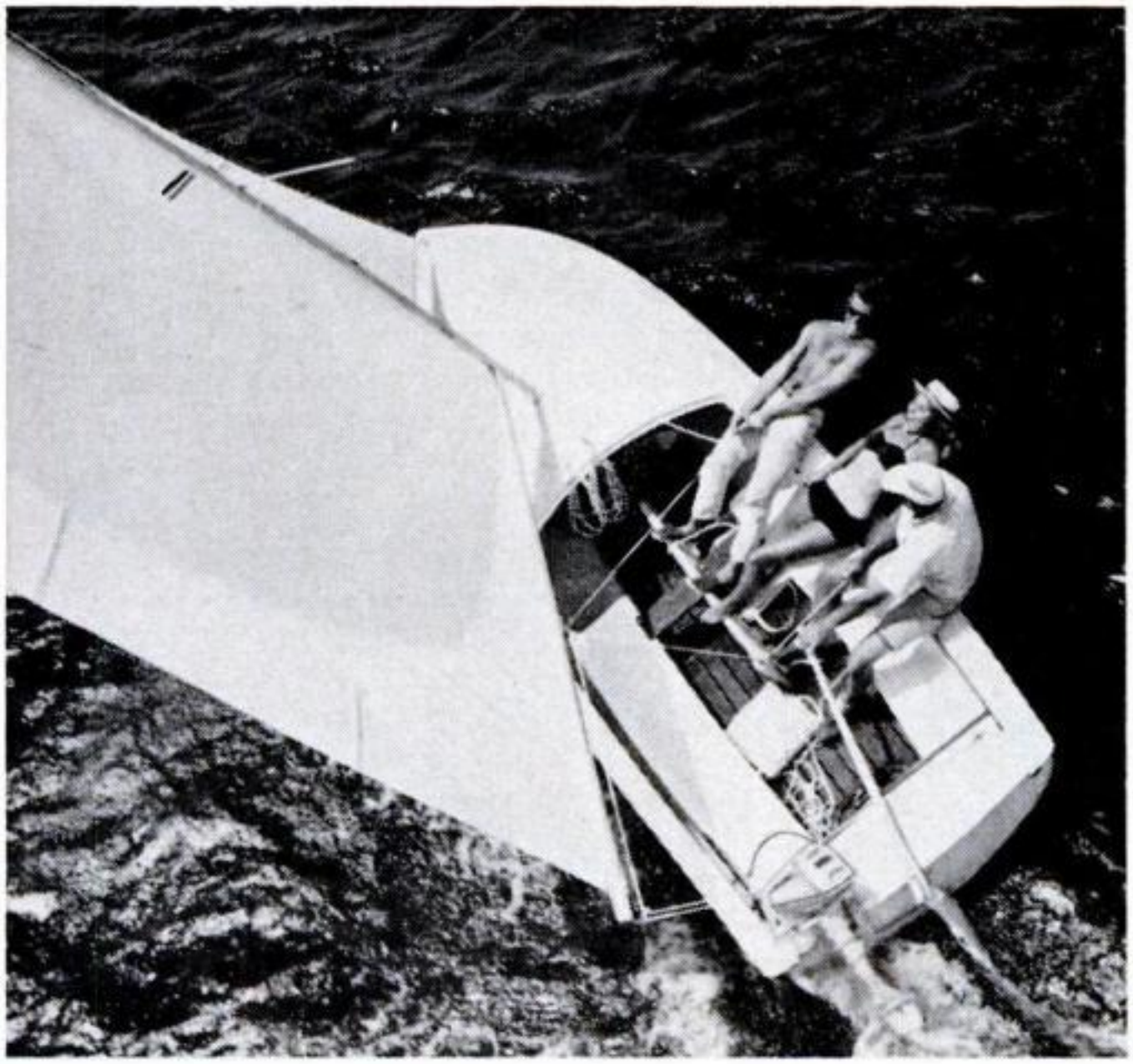
"Funny thing, but I found out some things I wouldn't have, if that dame hadn't bumped me," admitted Murch.

"That's how we learn," Gus said with a grin, "in the school of hard knocks." ■ ■

Urheberrecht ch geschütztes Mate al

Hunting for an outboard that packs almost twice the punch of a 3 hp engine, weighs only 9 lbs. more, and is priced so right it almost seems wrong?

Presto!
The carefree, new 5 *(a Sea-Horse, of course!)*



The Sea-Horse 5 represents a new idea for Johnson: an economy engine that's as simple and light and low-priced as can be made and still be all Sea-Horse. This new 5 is ideal for small, rental resort boats and for use as an auxiliary. And because its new low-compression cylinder head all but eliminates vibration, it's a truly magnificent troller.

Weighs only 43 pounds . . . so you know it's a cinch to carry—and a clean starboard side lets it stow flat as a guide's biscuits. Full-pivot 360° steering lets you reverse without a gear-shift.

No need to buy special marine fuels. From 3 to 90 hp, all 17 new Johnson models (including the nickel-nursing 5) use regular grade gas and oil. What's more, a new 50 to 1 gas-oil mix halves oil costs!

Only Johnson has sold over 2½ million outboards. You can be sure we know how to keep the Corrosion and Noise out. You'll like our 2-year warranty*. For the right engine to fit your needs see your Johnson dealer. He's in the Yellow Pages. Johnson Motors, 1944 Pershing Rd., Waukegan, Illinois. Div. Outboard Marine Corp. In Canada: Johnson Motors, Peterborough, Ontario.

*For 24 months after purchase, Johnson Motors will replace, without cost to the original purchaser, any part of its manufacture which upon inspection proves to have failed in normal use due to faulty material or workmanship.

Another carefree Johnson . . . first in dependability

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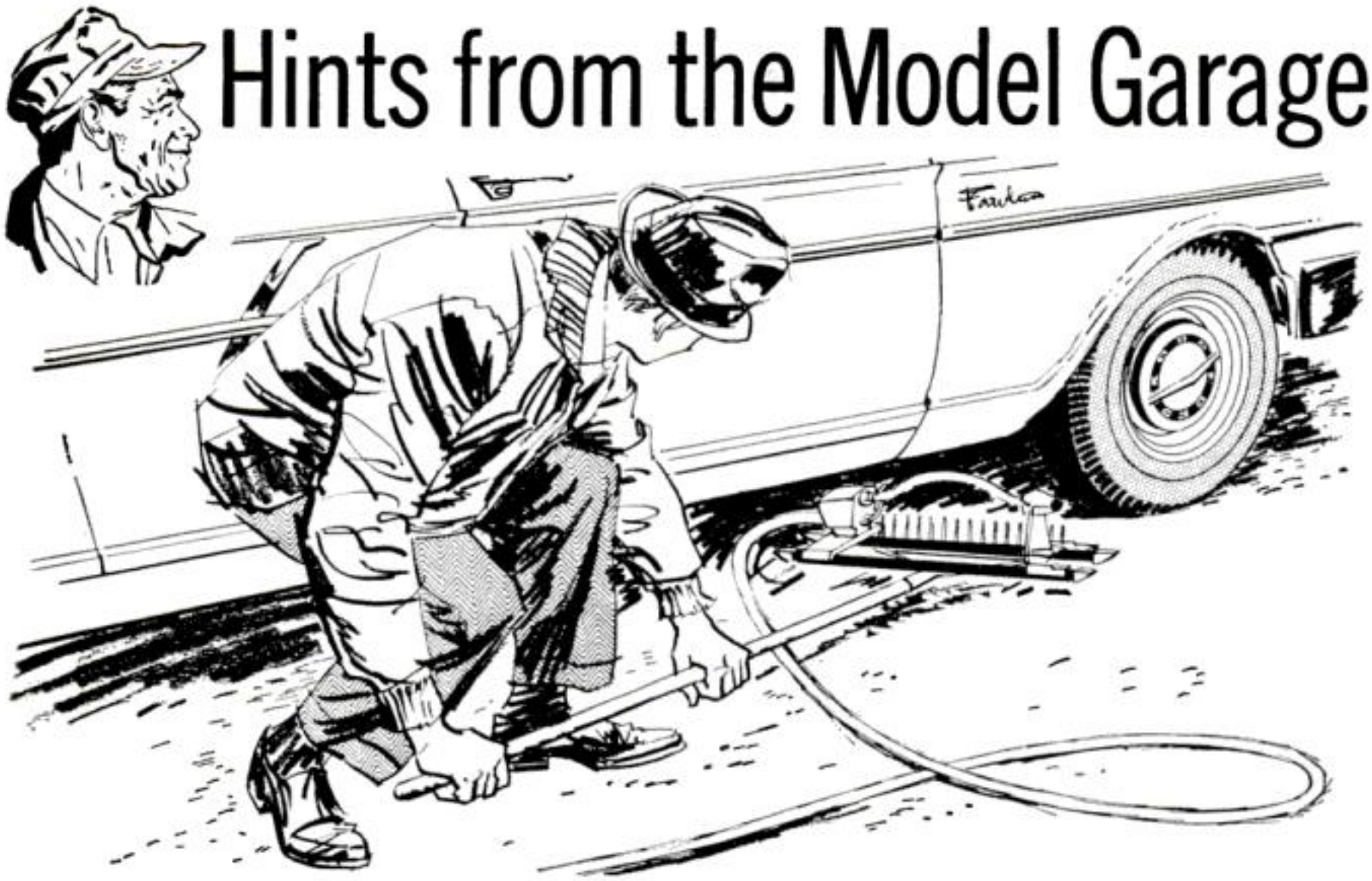
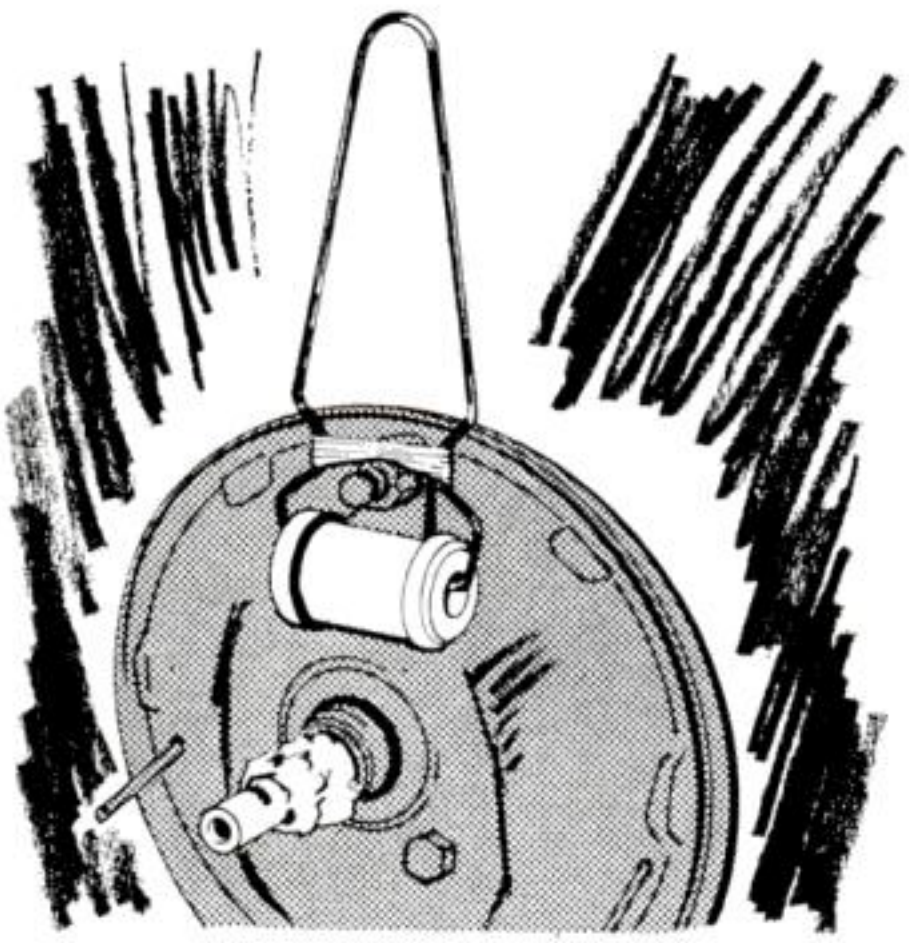
Hints from the Model Garage



Salt on the suspension and underbody of your car is highly corrosive. When you come back from a trip over salted winter highways with the underside splashed up, the best thing is to wash it off in a hurry. It's inconvenient and costly to have the car periodically steam-cleaned, so washing it off in your own garage is the best answer. Here's one good way: Wire an oscillating lawn sprinkler to a rake and slide it under the car. The oscillations reduce the number of times you need to move the sprinkler.



An effective home-made tool for keeping pistons in brake-wheel cylinders while you install new linings can be made from a heavy wire coat hanger. Shape the wire into tongs about 8″ long and add several rubber bands to keep the clamp tightly in place.

When the horn contact on '59-60 Thunderbirds becomes badly worn, a permanent fix can be made by cutting the tip off a metal tire-valve cap, and removing the rubber insert. Smooth off the cut and slip the cap over the contact-spring end to extend it.

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Urheberrechtlich geschütztes Material

BUICK MOTOR DIVISION

The new Riviera Gran Sport or, How we put muscles on the Riviera's muscles

If you start messing around with a fairly normal looking Riviera someday and it suddenly commences making loud noises and leaves you fast sinking astern, that we're happy to say, was no normal Riviera.

What we've gone and put together is a land version of the wartime Q boat, i.e., a merchantman with hidden guns.

What's this? you say. Buick rattling its sabre and uttering warlike cries? They're supposed to be in the business of making nice, big, reliable, well-engineered, soft-riding automobiles.

We still are. But we've opened a new branch office.

Which brings us back to the Riviera Gran Sport. It packs what might be termed pretty heavy artillery: 2-4BBL, 425 cubic inches, 360 horsepower and 465 lb-ft of torque. And it plasters all this down on the road via a limited-slip differential with 3.42:1 gearing.

The steering is power assisted, with an extra-quick 15:1 gear ratio available for it. The brakes, also power assisted, are massive 12-inch finned aluminum drums up front, 12-inch finned cast iron on the back. Specify the heavy-duty set of springs, shocks, and stabilizer bar and you have the complete Q boat.

Next month we're doing something loud and strong with the Skylark. Keep watching this space.

More Riviera Gran Sport Standard Equipment: *Automatic transmission—3-speed torque converter; 2¼" low-restriction dual exhausts; 8.45 x 15 tires on 6JK rims; bucket seats; console; padded dash; tilting steering wheel; full carpeting; 2-speed wipers; washers; map light; back-up lights; trunk light; smoking sets, front and rear; electric clock; speed warning buzzer; trip mileage indicator; things like that.*

Advertisement

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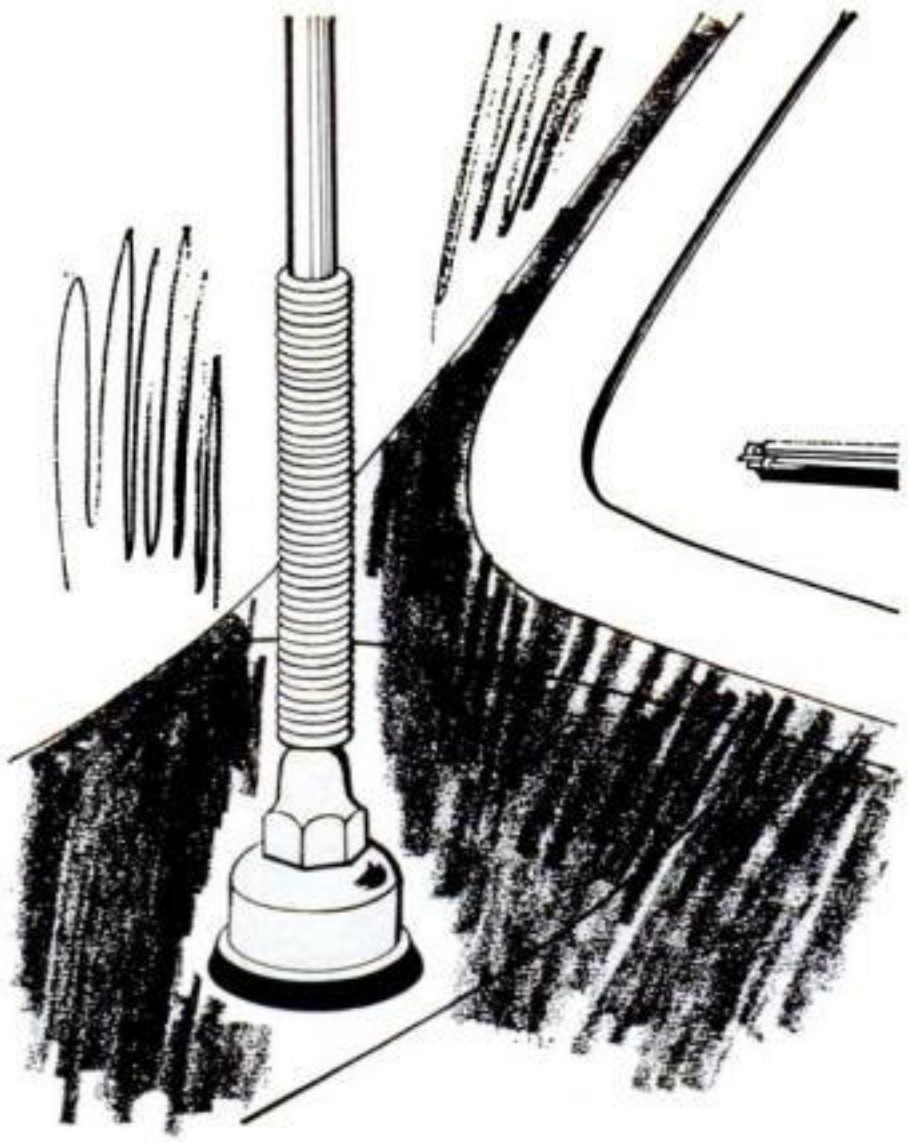
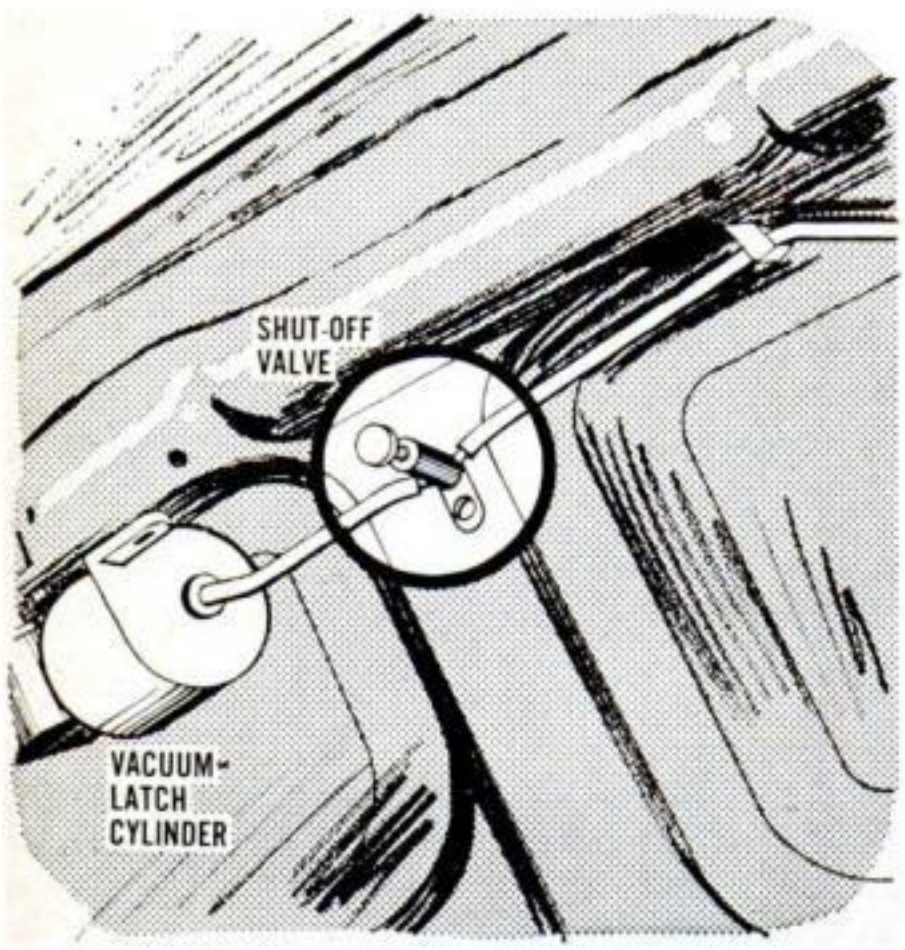
More Hints from the Model Garage

A headlight reminder could save you a dead battery. Put in an additional door-jamb switch at driver's side, connect it to a 12-volt buzzer and in turn to the glove-box lamp (hot only when headlights are on). Open the door and the buzzer sounds.



A broken radio-antenna staff can be neatly repaired at little cost by piecing the ends together with a heavy coil spring. Use a plated spring about 5″ long that will fit tightly over the ends of the broken antenna after they're filed smooth.



Safeguard a vacuum-operated trunk release by installing a cutoff valve in the vacuum line. This will keep a thief from opening the trunk by working the hose under the instrument panel. One of those valves used to aerate fish aquariums works fine.

Mounting tires can be made easier by lubricating the beads before you start to lever them over the edges of the wheel rims. A squirt or two from a handy squeeze bottle of any liquid soap (not detergent) will work wonders for you as a labor saver.

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"You need cooler plugs for hotter performance"

says Rodger Ward, two-time Indianapolis 500 winner

I don't know of any scientific way to pick the right heat range spark plugs that beats the old cut-and-try method. Engines vary. So do driving conditions. Plugs that work fine in one engine just won't hack it in another one that came off the same line!

We start with the heat range recommended by the manufacturer. We run for a while and yank the plugs. When you're running hard, you're apt to need cooler-than-normal plugs—especially with a modified engine. Fused deposits, fast electrode wear and cracking at the insulator nose indicate plugs that are too "hot" for the engine and driving conditions.

If you run across this, try plugs one step colder . . . they have insulators with shorter noses and are assembled deeper in the plug shell. They run cooler because they throw heat off to the cooling system faster. Generally, the coolest plugs you can run without fouling give you top performance.

Heavy oily deposits mean you need plugs with longer noses that run hotter to burn off those deposits. No matter what kind of plugs you run, don't just stick 'em in and forget 'em! They should be cleaned and gapped every 3,000 to 5,000 miles—and replaced at about 10,000.

And when you buy spark plugs, get Autolites. I use 'em racing and in my family car and plane. Autolite makes its passenger-car plugs with the same copper and glass seals used in racing plugs. It costs a bit more, so some companies don't bother. Autolite thinks the extra efficiency you get is worth it. So do I.

AUTOLITE SPARK PLUGS

PRODUCTS OF Ford MOTOR COMPANY

HERE IS A PARTIAL LIST OF RODGER WARD'S RACING ACCOMPLISHMENTS: Indianapolis 500—Winner, 1962, 1959; 2nd, 1964, 1960; 3rd, 1961; 4th, 1963. USAC National Champion, 1962, 1959. Winner of 25 USAC National Championship events, including 1963 Hoosier 100, Milwaukee 100, Sacramento 100; 1962 Trenton 150, Milwaukee 200, Syracuse 100, and many others.

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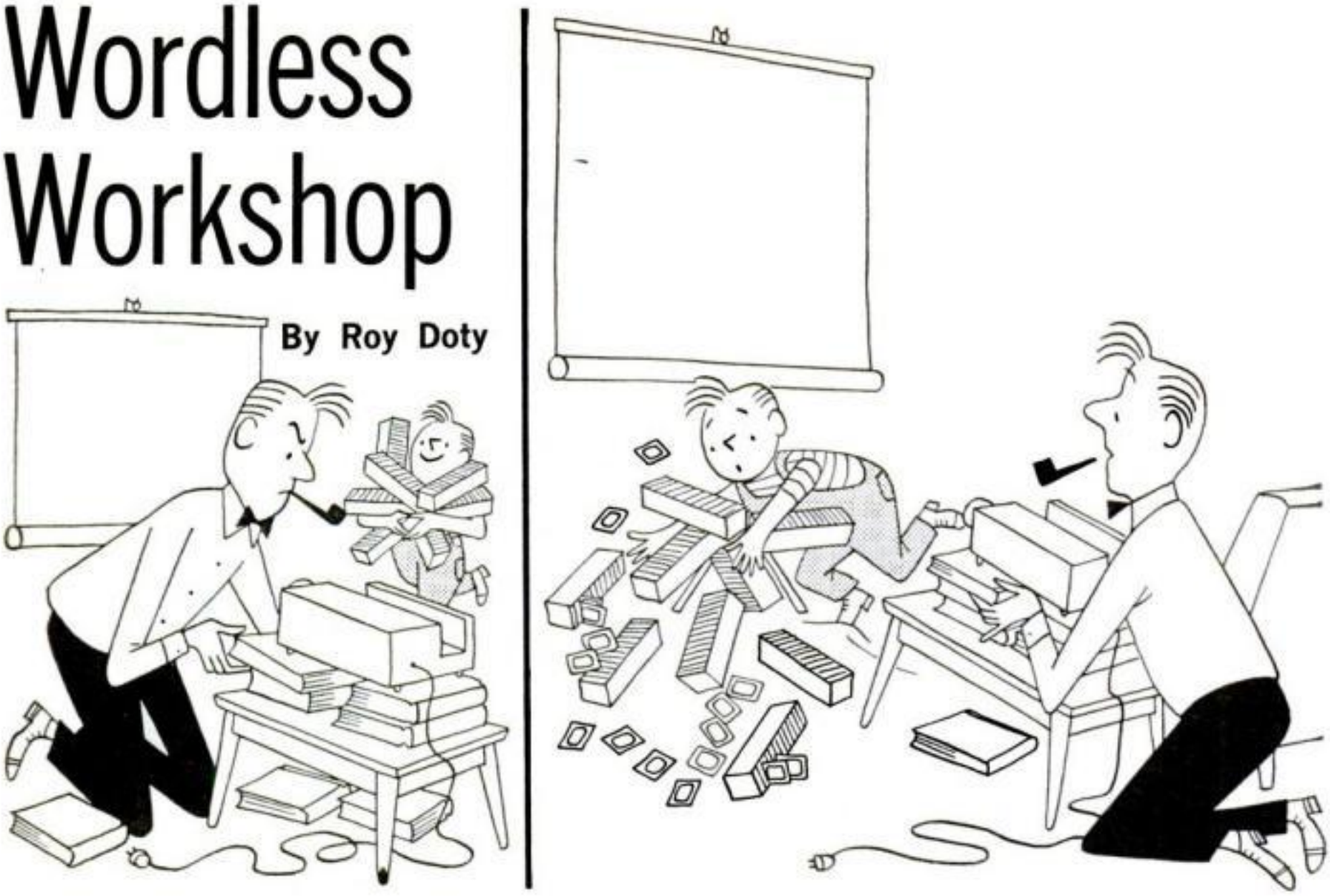
Wordless Workshop

By Roy Doty



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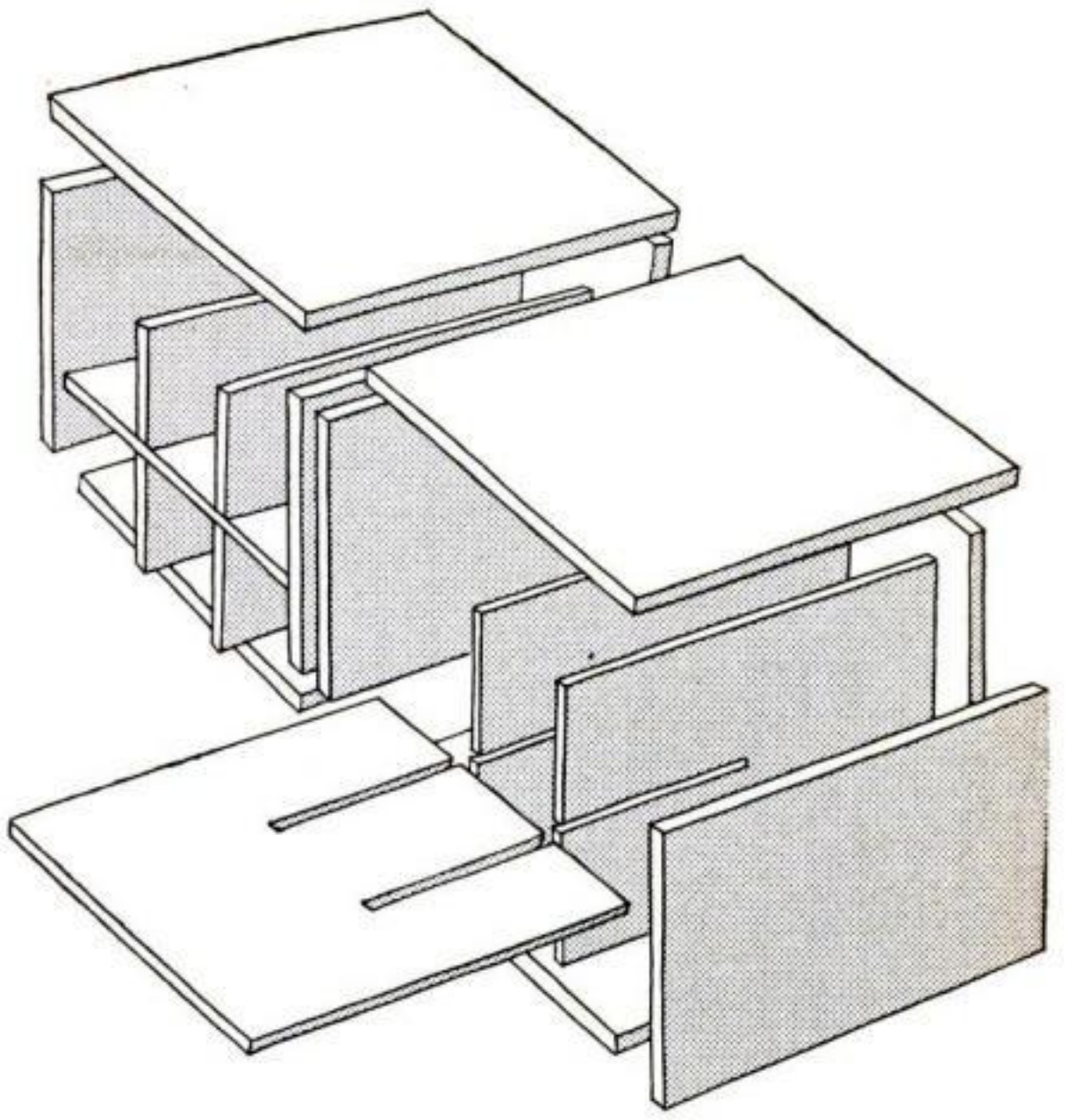

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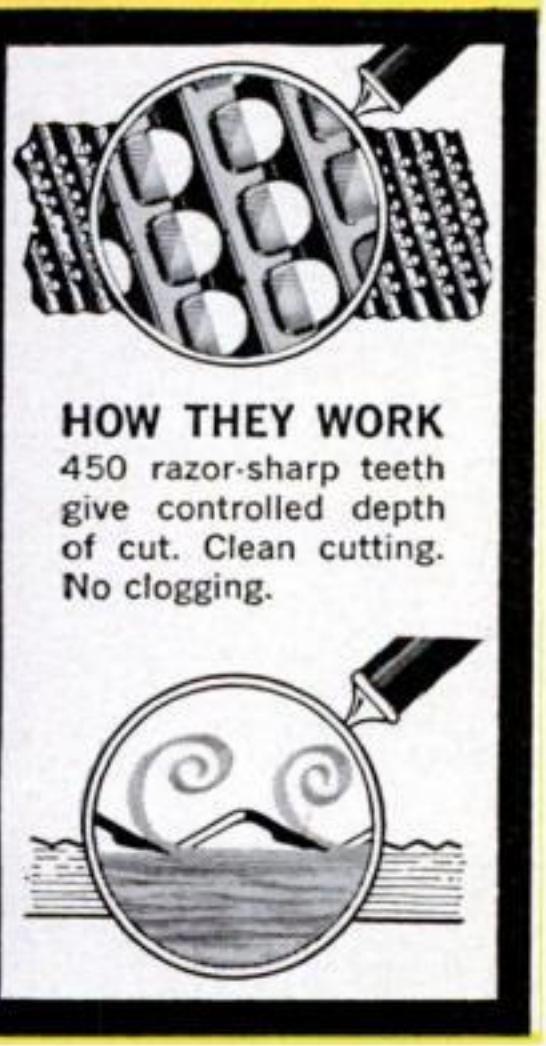

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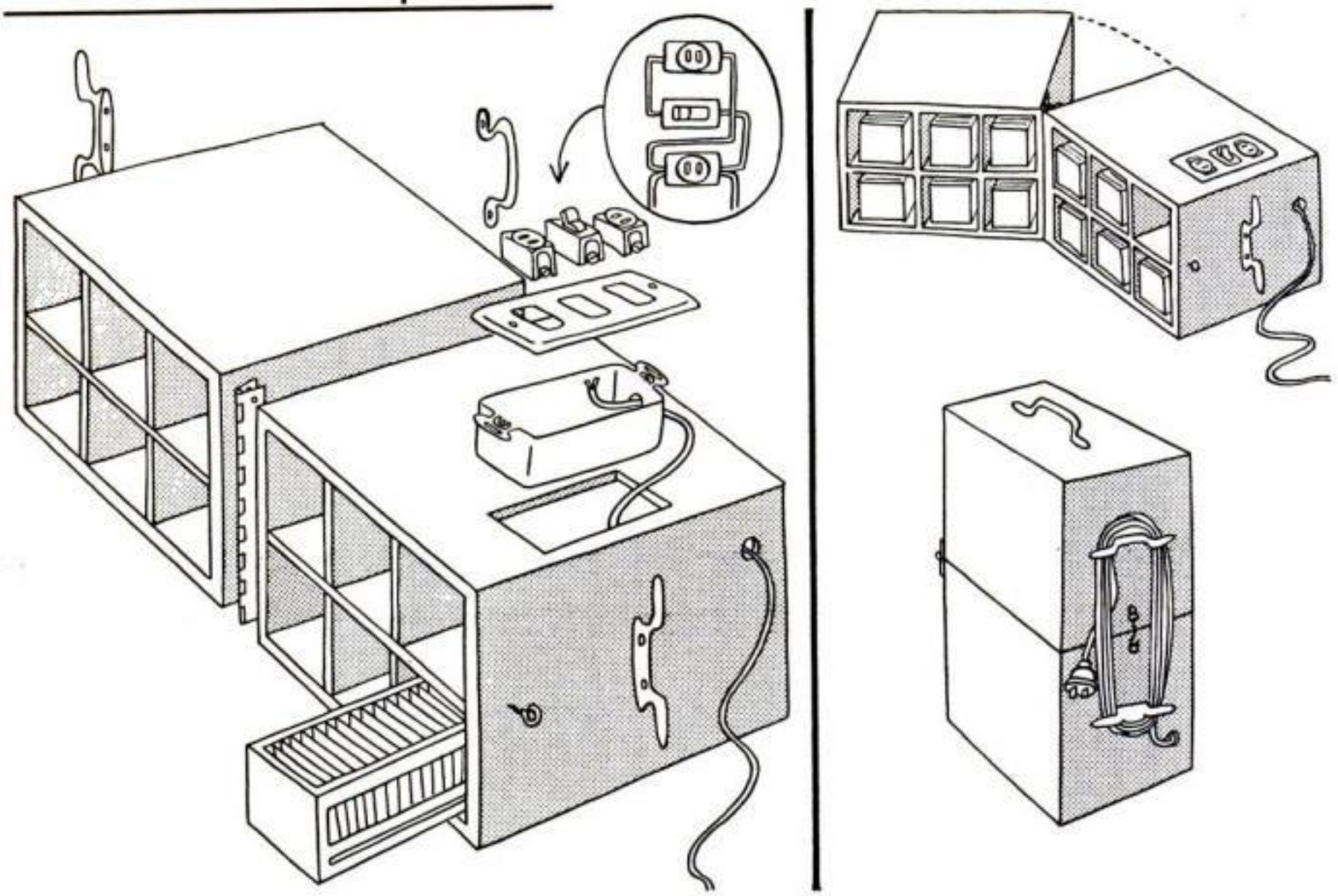
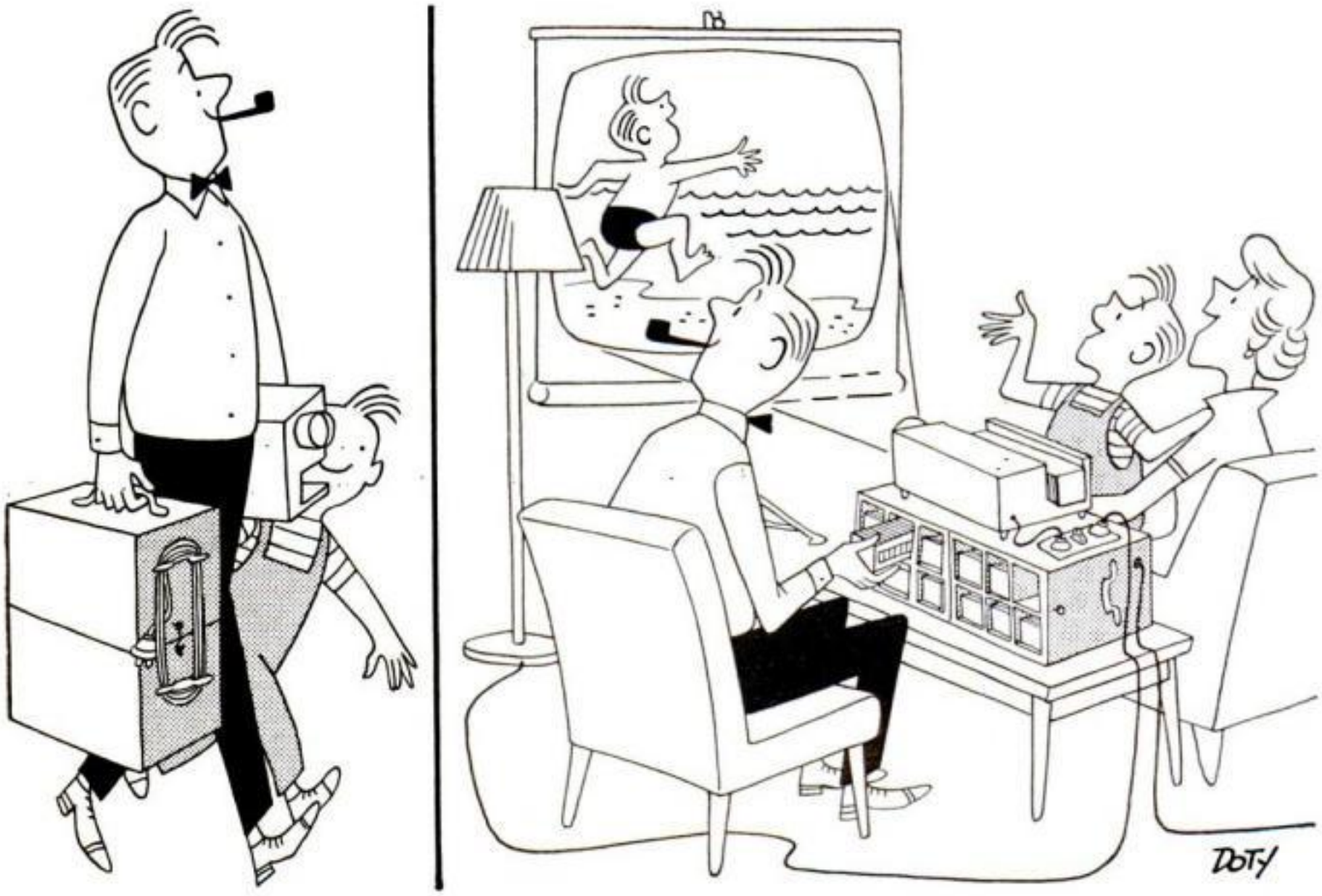
Wordless Workshop continued





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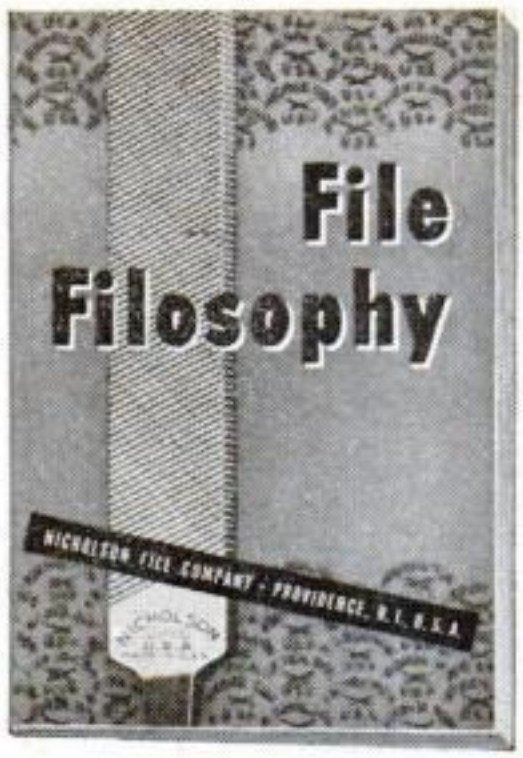

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Comparing the Compacts

[Continued from page 96]

car leaps forward right from under you.

The engine is a quiet and smooth seven-mainer with plenty of power. Wind noise isn't objectionable. Transmission action is good; it takes off smoothly and shifts without jerk.

The Rambler is quite comfortable on good surfaces. But the car reacts on longitudinal cracks a bit more than I like. It is joggy on broken concrete and expansion joints, about on a par with the Falcon. Lean in cornering is not excessive, but cornering is a bit insecure on sharp, fast downhill turns on broken concrete.

I'd give an unqualified okay to Rambler's engine-transmission combination; the car really hustles. Even with a vacation load, you'd have enough power to punch you around for quick passing.

The Valiant. Although it doesn't have the power and jump of the Rambler, the Valiant seems the best-balanced performer of the four. Steering and suspension geometry makes it the best from a control standpoint. The relationship of seat-to-wheel-to-pedals for the driver is better than in the Falcon or Rambler, and equals that of the Chevy II. The body is a well-balanced design, although not quite as roomy as the Chevy II's.

Although the Valiant is completely squeak-free, there is a good deal of low-key shuddering—as if the car were mounted on boxing gloves. The engine is dead smooth. I'd rank Valiant, Chevy II, Rambler, and Falcon in that order for engine noise.

For all of its light weight and shortish wheelbase, the car holds very steady on winding, cambered blacktop. Cornering roll is minimal; the suspension gives a little and then returns. The car is very cat-footed. There's a lot of rubber in this suspension, and it takes rough blacktop nicely.

Of the four, the Valiant would get my vote over Chevy II by a narrow margin, principally because its three-speed automatic is more efficient and because of a slight but discernible superiority in handling.

Too bad we couldn't have a composite of the four, with Chevy II's solid, roomy body; Rambler's lush adjustable seats; Valiant's stable, comfortable suspension and accurate steering; and Falcon's efficient engine and transmission, with axle ratio changed from 2.83:1 to 3.00:1 for a little added pep. ■ ■

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Inside Our First Two-Man Spacecraft

[Continued from page 145]

the vehicles. That seems tiny, but as someone remarked, "If you walked into a door at 1½ m.p.h., you would feel quite a bump."

Gemini's remarkable little computer is rather like a superintelligent third crew member. By feeding the variables into it on a small keyboard, the pilot not only can get instant information vital to maneuvering in space, the computer will also tell him precisely where he'll land whenever he's ready to start the homeward plunge from orbit to ocean.

Gemini had been expected to improve on Mercury in two important ways that have not yet proved to be feasible. One was the means of obtaining electric power. The other was the method of landing.

No fuel cells—yet. Program planners had hoped to provide the Gemini spacecraft with electricity produced directly by mixing hydrogen and oxygen in fuel cells. The fuel cells would weigh far less than the old, reliable silver-zinc batteries used in the Mercury program. Furthermore, they would produce drinking water as a precious by-product of their chemical reaction.

The fuel cells work, but they are not yet considered sufficiently dependable for a manned spacecraft. They'll be tried out for a while longer on the ground.

Until then, the heavier silver-zinc batteries will supply manned Gemini missions with electricity. Drinking water for the astronauts will be taken aboard the capsule before launch.

Gemini's sponsors had also intended that the re-entry module should be able to make dry landings, with considerable precision, instead of dropping by parachute into the sea, as all the Mercury capsules did.

Dry landings were to have been made by inflating a "paraglider" at around 42,000 feet above the ground and sailing down to a safe and reasonably soft touchdown wherever the spacecraft commander chose.

The paraglider had seemed to be shaping up fine for its intended role in test flights at Edwards Air Force Base. NASA research pilots had successfully flown a smaller version of it, on a kind of aerial tricycle, to precision landings a good many times. But when the paraglider was tried out on a boiler-plate copy of the Gemini re-entry module, under control of another pilot, it immediately went into a left turn after be-

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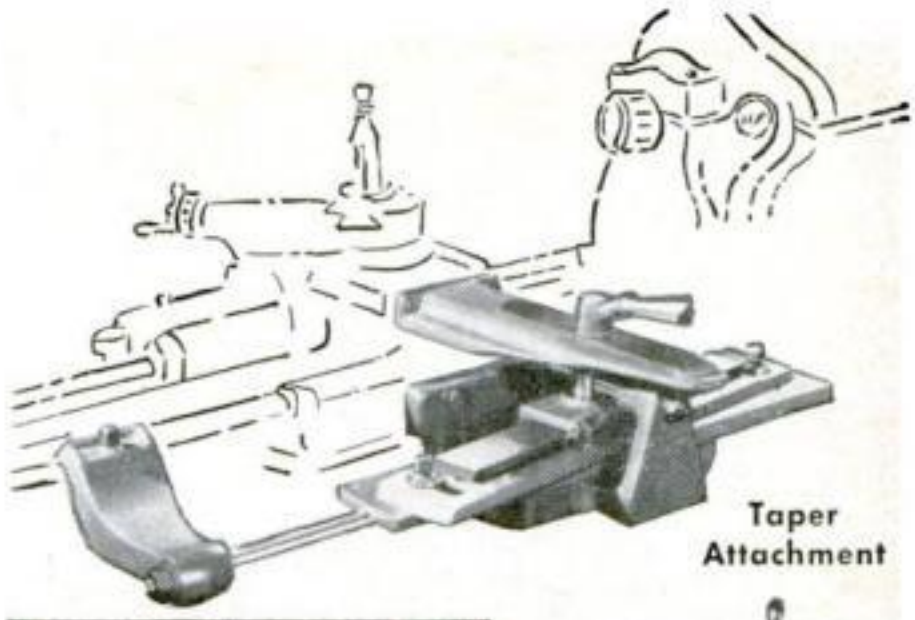

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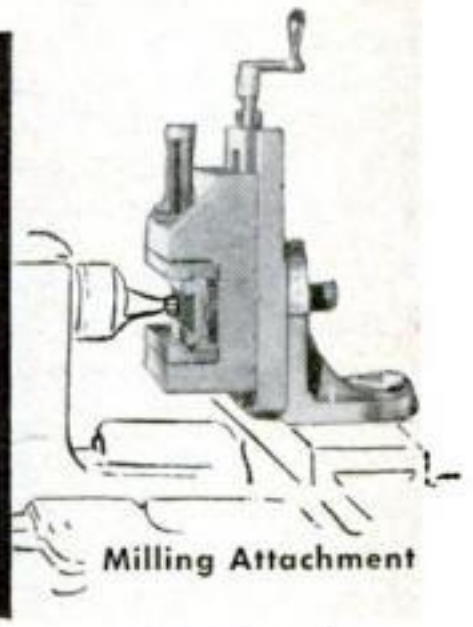

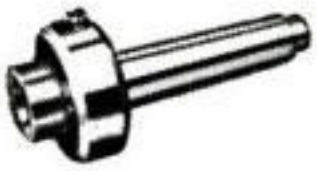

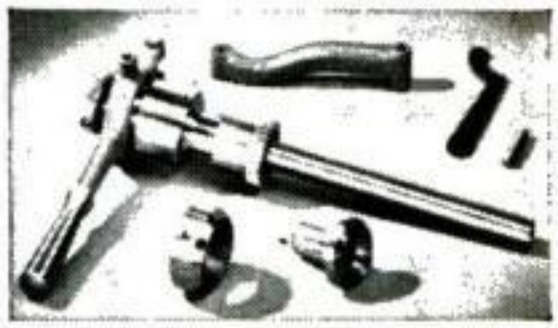

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For quiet — at idle the Grand Prix model is so silent that you'll have to double check to be sure it's running. At any speed it's as quiet as a running engine can be.

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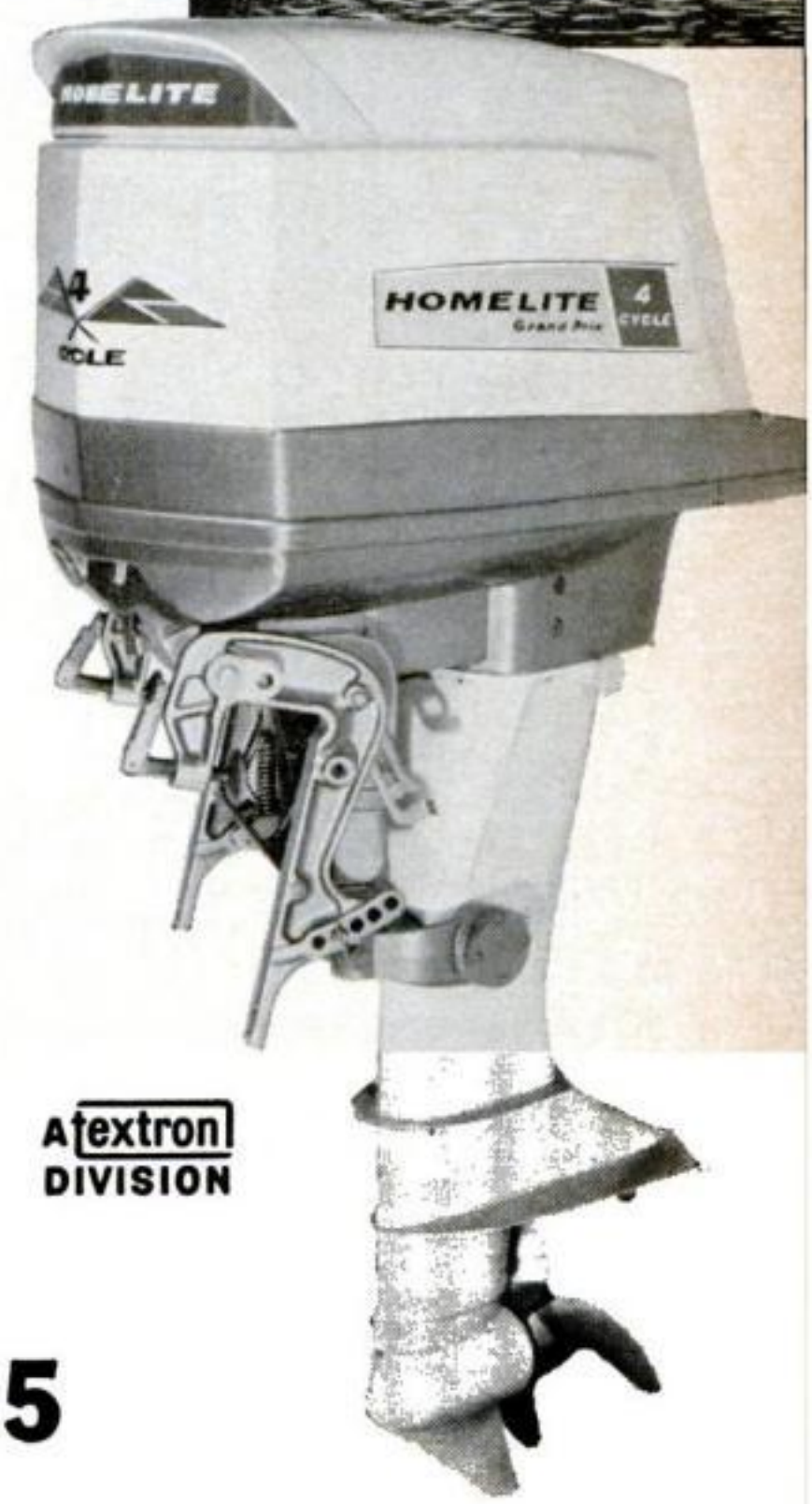

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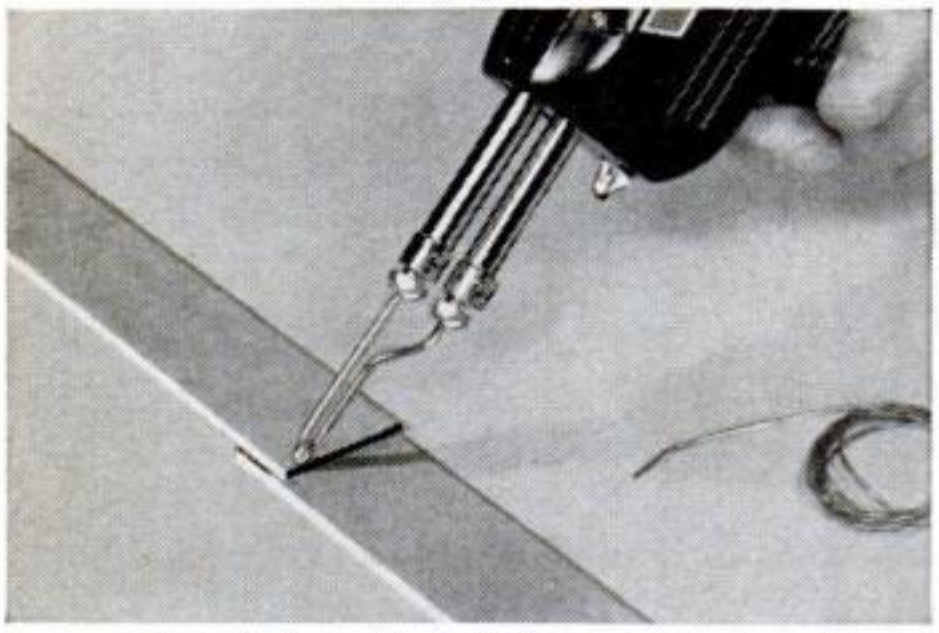
SOLDERING TIPS FOR HOUSEHOLD REPAIRS



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Apply flux to both pieces of metal. Get them hot enough to melt solder. Then coat each piece with a rubbing action. Pre-tinned pieces can then be sweated by applying heat as shown.

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Kit includes gun in rugged plastic case; tips for soldering, cutting and smoothing; tip-changing wrench; solder. Model D-550PK—$12.95 list. Weller Electric Corp., Easton, Pa.

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ing drop-launched at 13,000 feet, and the pilot couldn't bring his bell-shaped craft out of the turn. He bailed out at 2,000 feet, and the boilerplate hit the ground at 50 feet a second.

Ocean landings. Development work on the paraglider landing device for spacecraft will continue, but all Gemini landings will be blue-water splashes, in the Mercury tradition. The only difference: The bigger, heavier Gemini vehicle will use an 84-foot parachute instead of Mercury's 60-footer.

Unlike the Russians, we have not yet found a satisfactory way to land a spacecraft by parachute anywhere but in the sea. Our spacecraft are not maneuverable when dangling from a chute, and thus are unable to dodge possible ground hazards, such as trees, rocks, or gullies. Furthermore, even in a perfectly clear area, the shock of landing the craft on ground would be too severe to risk.

Other troubles have also afflicted the Gemini program. In December, failure in a hydraulic line caused an automatic shutdown of both Titan II engines, aborting a 2,150-mile test launch down range, and setting the program back an estimated month.

Seldom mentioned, but surely in most people's thoughts at the time an astronaut is circling the earth, is the unavoidable question of toilet habits. What does he do?

Well, though it means temporarily depressurizing his suit and relying on cabin pressure alone to keep him alive, an astronaut can unzip as far as he needs to. Waste disposal on spacecraft is still rather crude, but adequate. Solid waste is retained in plastic bags. The bags are sealed and tucked away in cubicles for eventual disposal on earth. For liquid waste, each Mercury astronaut used a pressure-suit bladder. Gemini's two-man crews will use a relief tube containing a tiny pumping device that guarantees flow to an 800-cc. reservoir. The tank is only temporary, however. When the user of the relief tube removes the cone at the top, a valve closes, and the reservoir's contents are dumped overboard, perhaps flung into perpetual orbit in the form of frozen particles.

For the far longer space missions of the distant future, NASA anticipates being able to process crew waste on board and utilize the purified moisture from it for washing and drinking water.

Space travel, anyone? ■ ■

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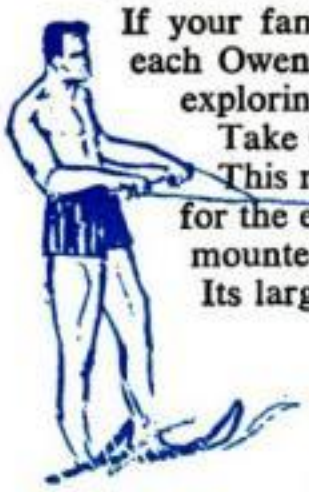
JUST FOR THE *family* FUN OF IT



If your family enjoys the pleasure of each other's company, they'll love the fun built into each Owens cruiser. And . . . whether your crew fancies swimming, photography, fishing or exploring, they'll find Owens cruisers feature built-in versatility as standard equipment.

Take Owens' 26′ "Raider" Sea Skiff Express, for example.

This rugged lapstrake cruiser has a spacious (9′ 3″ x 7′ 8″) cabin with ample headroom for the extra tall sailor. The galley of this beamy four-sleeper is complete with flush-mounted stove, porcelain enamel sink, dish locker and ice box.

Its large cockpit (10′ x 9′) boasts a flush teak-vinyl covered deck. (There's no cumbersome, unsightly engine box wasting valuable deck space.)

Foredeck of this robust cruiser is teak veneer. Sturdy, mahogany-faced marine duraply lapstrakes cover the "Raider's" Philippine Mahogany Framework.

And . . . there's a reliable Flagship V8 Marine Engine to power Owens' proven FLD hull. With a draft of less than 3 feet, any waterway is open to your Owens.

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PS PICTURE NEWS

Wagon lift for job on a steep roof

Junior's "little red wagon" was put to good use on a recent Topeka, Kan., construction job. Faced with the chore of carrying materials up a steep church roof, workmen improvised a simple pulley arrangement for hauling the loaded cart up the incline, as the photo shows above.

Fastest German diesel locomotive

A 126-ton locomotive, now in service on the German Federal Railways, is not only the railroad line's fastest (100 miles an hour) but its most powerful (4,000 horsepower). Maximum speed limits can be preset for use of the V320 as an express passenger engine or a slower freight-train hauler.

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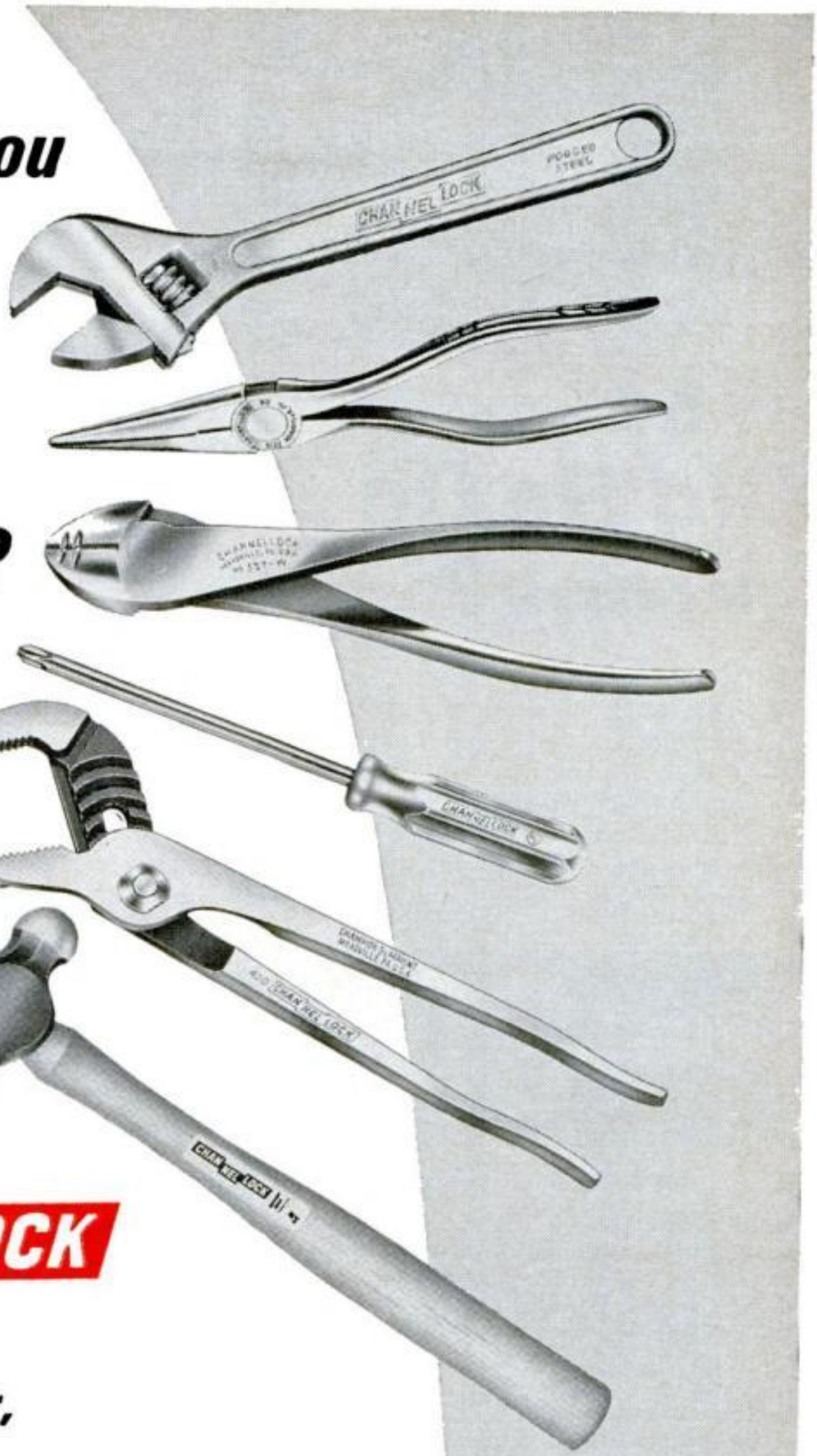

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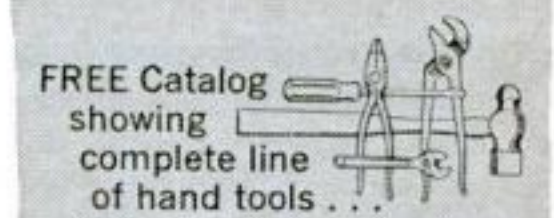

FREE Catalog showing complete line of hand tools . . . yours for the asking.

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What Did He Do Wrong?

THE 29-foot cabin cruiser headed for a Chicago beach on Lake Michigan. Lifeguards were startled when it kept coming and didn't stop until it ran aground, completely out of water. There was no one aboard. The boat carried three life jackets, eight buoyant cushions, and an uninflated rubber lifeboat. The automatic pilot was set and the throttle was at cruising speed.

Police investigated, concluded that the operator of the boat had set out alone from Chicago to St. Joseph, Mich. The Coast Guard station at St. Joe logged his cruiser out of there, apparently bound for Chicago. Coast Guardsmen believe the operator set the automatic pilot after clearing port and that, while on deck, he slipped and fell overboard. The Coast Guard report leaves to the imagination the pathetic picture of a man treading water while his boat, containing a normal complement of life jackets, continues on course to Chicago.

Here's what:

What did the skipper of this boat do wrong? Two things. He went out alone. The "buddy system," a cardinal safety rule of swimming, is equally important in boating. Your companion, in an emergency, should be able to operate the boat. Second, he should have worn a lifeline—always advisable when working on deck if the boat is under way or in rough water. Ocean sailors are not too proud to wear a lifeline. When you're alone, parting company with your boat and life jacket can make a small lake or a river your ocean.

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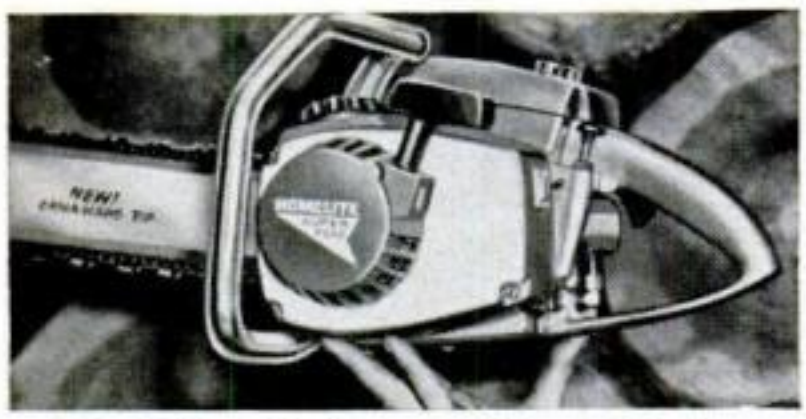

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How to Get the Best from Twist Drills

[Continued from page 150]

two to three times the listed speeds. Harder materials like tool steel, steel forgings, and the softer stainless steels and titanium alloys should be drilled at one-half to one-third the listed speeds. Work-hardening stainless steels are best drilled at a quarter of these speeds.

Where it's impossible to use the correct speed for a particular material, as when you're working with a fixed-speed tool, it's best to drill in short bursts. Keep removing the bit every few seconds to let it cool.

Special drill points. The standard point angle of 59 degrees (from the drill axis) is a compromise to suit the average range of metals. You can often improve a drill's cutting efficiency by selecting a point angle better suited to a particular material.

Drills made specially for use in wood are pointed at 30 to 45 degrees. Such sharp points are also effective in soft cast iron, hard rubber, fiber, and some aluminum and zinc alloys. A point angle flatter than normal—68 to 70 degrees—is recommended for certain stainless steels, manganese steel, and other tough alloys.

Such special drill points, though not commonly available, can usually be obtained at industrial-supply houses. A machine shop will also grind one for you, or you can grind your own.

A twist drill's web normally ends in a chisel edge that has negative rake and thus does little cutting. For drilling hard materials or deep holes, the chisel edge is sometimes modified to have positive rake. This reduces feed pressure, breaks up chips for easy ejection, and makes the drill less likely to skitter about on starting. Usually the point angle is ground greater than normal—64 to 68 degrees. Several ways of grinding split points are shown.

In brass or bronze, drills tend to "hog in" and grab the work violently. With smaller drills, lower speeds and firm clamping of the work will minimize this hazard. On larger drills, it can be prevented by grinding a small flat at the front of each cutting lip (see drawing). For drilling aluminum, which tends to pack in the flutes and weld itself to the cutting lips, the flutes should be clean and polished, and a cutting compound should be applied.

Smooth the way. Use cutting fluids for steel, wrought iron, copper, and deep holes in brass and bronze. A lubricant less-

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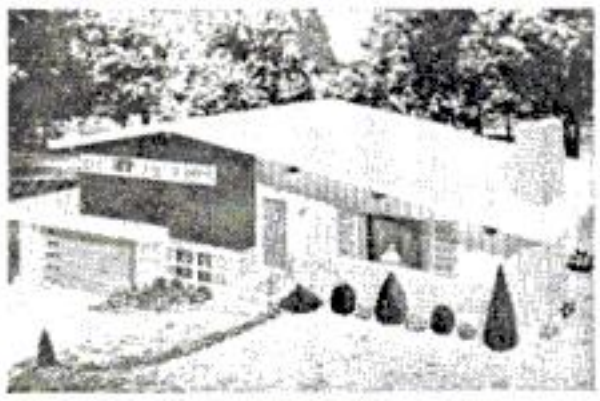

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ens friction, helps cool the drill, and promotes chip removal.

Ideally, a cutting fluid should be delivered in a constant flow to the point of the drill. But if you don't have an automatic coolant system, even oil-can application is better than none. On the other hand, some materials are best drilled dry, as the chart shows.

Know your drill sizes. Fractional-inch drills range from 1/64″ to ½″ and larger, in steps of 1/64″. These are the most popular for general shop work, but are by no means the only drills that exist.

Wire-gauge sizes, commonly used by machinists, start from a hairline No. 80 (.0135″) and go to No. 1 (.228″). A letter-size series begins above No. 1 and runs from A (.234″) to Z (.413″). Except for size E, which is an exact ¼″, letter-size drills lie between fractional-inch drills. They are useful as tap drills and for undersize holes that are to be reamed to a fractional-inch size. Size D (.246″), for example, is just right for holes to be reamed ¼″.

Tipoffs to drill quality. Look for smoothly polished flutes and margins. The drill, if it's straight, should roll evenly on a flat surface such as a saw or drill-press table. The shank should be a close fit in the hole the drill makes. If it's loose, the bit is drilling oversize, and the point is not properly ground.

You can identify high-speed and carbon-steel drills by a spark test. In subdued light, grind the shank end gently. Carbon steel will produce a generous shower of white sparks. High-speed steel produces fewer sparks, shading from orange or red near the wheel to straw farther away.

Carbide drills. These, though costly, will make many times the number of holes that high-speed drills will before resharpening is necessary. They are worth their price if you drill much cast iron (which is so abrasive it rapidly dulls any steel drill), masonry, or glass. Use the same or slightly higher speeds than for high-speed drills, but with a slower feed. Coolant should be flowing *before* the drill starts to work, for cold fluid applied to a hot carbide tip is likely to crack it.

For glass, run carbide drills at a fifth of the speeds given for high-speed drills in steel. Feed gently by hand, with water, turpentine, kerosene, or soluble oil as coolant. ■■

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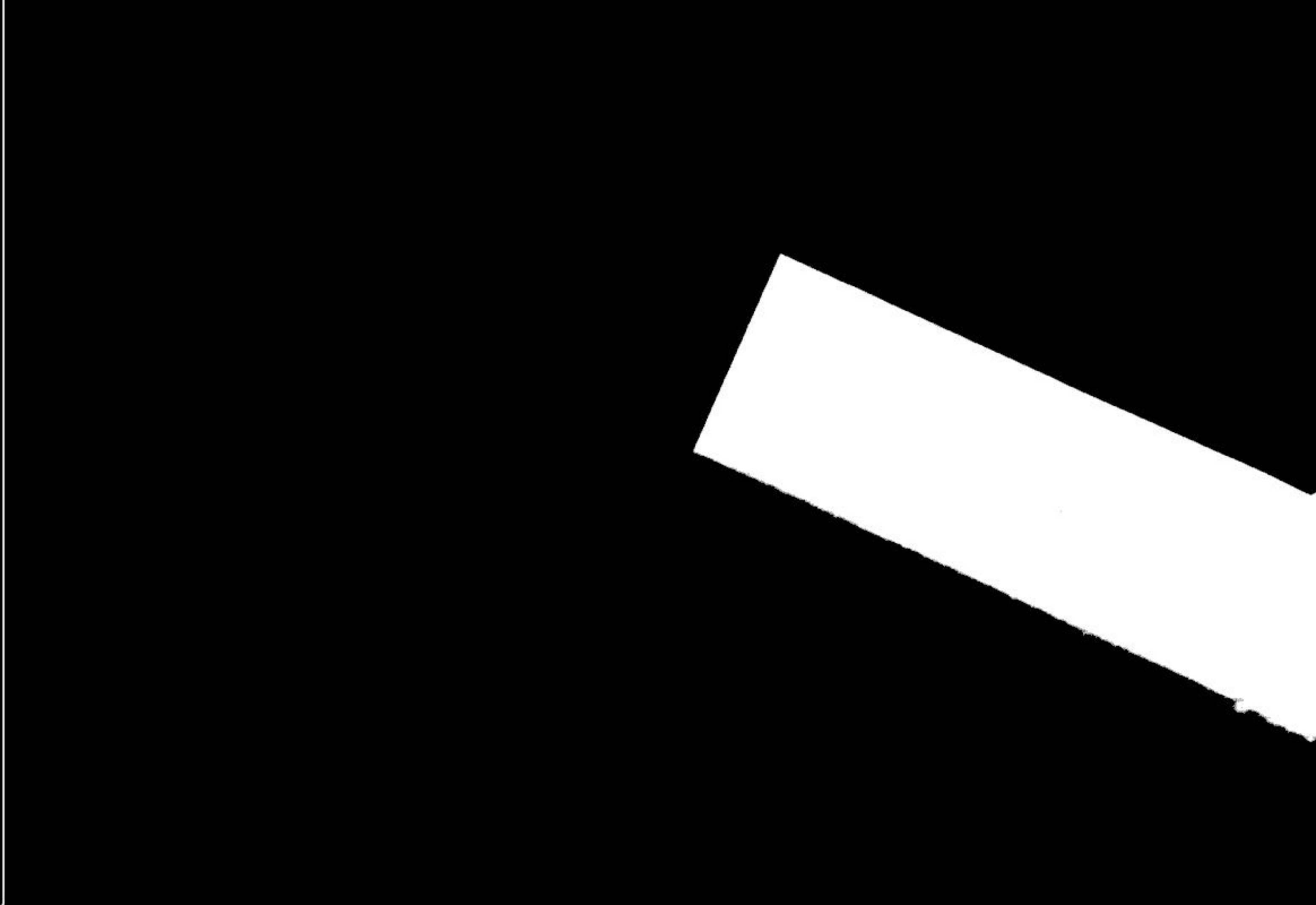

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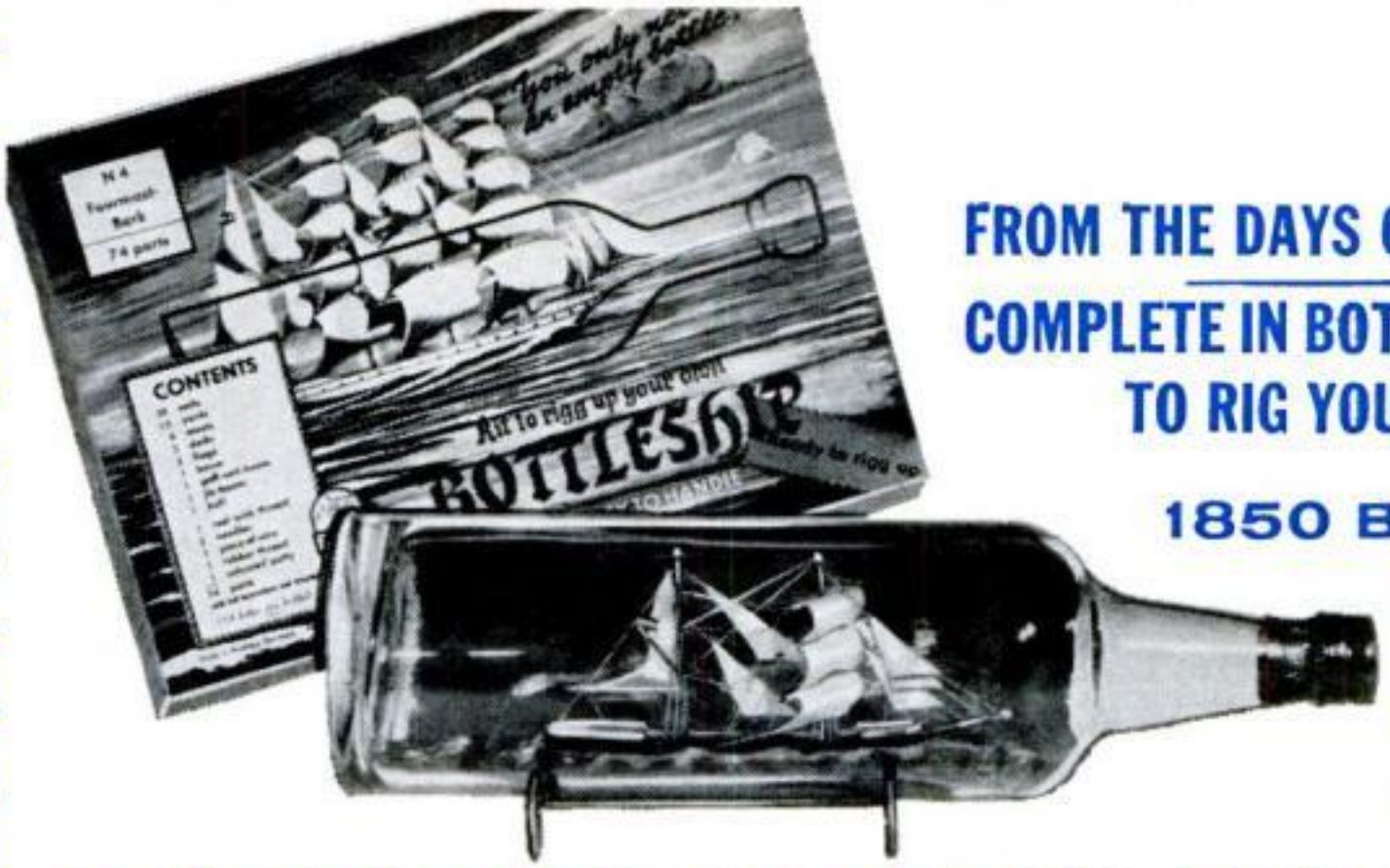

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[*Continued from page 138*]

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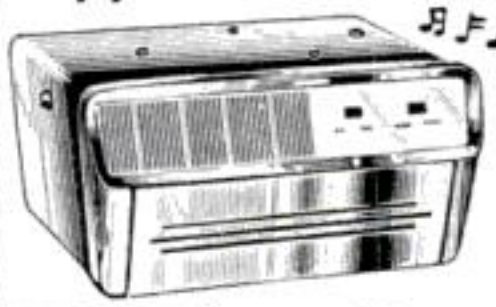

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Gleaming chrome plated metal case provides lasting beauty, long-life, durability. Complete with mounting brackets, hardware and instructions. Easily installed under dash. For all cars and trucks with 12 volt systems and equipped with radios.
No. 131—Each..... **$69.95**
ADD $1.55 FOR POSTAGE & INSURANCE

PLAYS TWELVE RECORDS WITHOUT STOPPING

Enjoy the luxury of uninterrupted music of your choice.

Play up to twelve 45 RPM records without stopping, without touching the player or records. Load it—forget it until last record is played. Fully shockproof . . . plays without skipping while you are driving. Equipped with On-Off switch and Start and Reject switch for manual operation when desired.

45 RPM SINGLE PLAY RECORD PLAYER. For all cars with radios. Completely automatic—switches on by itself, cleans needle, sets needle arm on disc, plays, switches off, and rejects disc. Fits below instrument panel and plays through radio. Size: 9" wide x 8" deep x 10" long.
No. 38—Each..... **$51.95**
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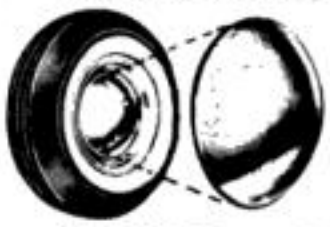
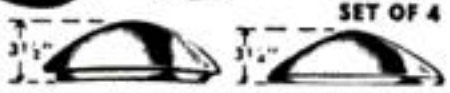
Baby Moon HUB CAPS for All American Cars



NEW CALIFORNIA WHEEL STYLING CRAZE!
only **$5.88** SET OF 4



- **Deep-domed moon-shaped hub caps give a custom 'racy' look to any car.**
- **Gleaming chrome plating adds sparkling beauty to car in motion, or standing still.**
- **Can be installed in seconds—fit perfectly.**

All "baby moon" hub caps have beaded edge that snaps easily over projections on wheel. Made of heavy gauge steel. All are 3¼" depth, except 57-65 Dodge and 55-65 Plymouth, which are 2¾"; and 40-48 Ford, 40-65 Ford ½-Ton Pickup, 40-48 Mercury, and 50-58 Olds., which are 3½" depth. Available for all standard and compact American cars. **State Make, Year and Model of Car or Truck, Plus Size of Wheel, and Stock Number when ordering.**
No. 180—Per Set of 4..... **$5.88**
No. 181—Each..... 1.65
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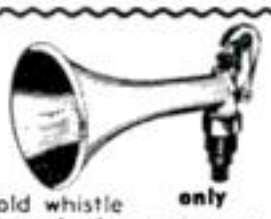
DELUXE *Hollywood* WOLF WHISTLE



Precision made intake manifold whistle that gives the wolf call, imitates a barking dog . . . and other effects. Distinctive, unusual, attracts attention. Easily installed on cars, trucks.
No. 61—Each. **POSTPAID**.....$3.75

only **$3.75** EA. POSTPAID

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Loud, penetrating, hi-speed siren—used by hundreds of fire and police departments, buses, ambulances, other emergency vehicles. Complete with bracket, screws, 10-ft. of cable and push button. Bright red enamel finish. **POSTPAID.**

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Each
No. 71— 6 Volt.
No. 91—12 Volt. **$14.95**

"STOP Car Thieves" Auto Burglar Alarm

Let this private policeman protect your car 24 hours a day. Safeguards hub caps, tires, radio, battery, tools, luggage, personal items. Completely automatic — sounds loud intermittent blasts of horn if car is molested. Easy to install. With on-off switch, instructions. Fits all cars.
No. 17—Each.
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Gives you TWO exhaust systems in ONE for
- **More Horsepower**
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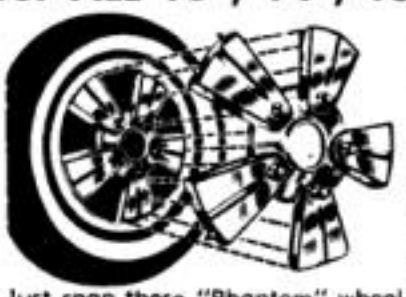
Exhaust and tone are controlled from dash—can be used as a cutout in the country, closed in restricted areas. For cars with exhaust pipes 1¾" to 2¼".
No 613—Each.
POSTPAID.....$3.25

only **$3.25** EA. POSTPAID

"Phantom" Wheel Covers for ALL 13", 14", 15" WHEELS



only **$24.88** SET OF 4

Give the look, the style of Continental wheels at a fraction of the cost of the real thing!

Just snap these "Phantom" wheel covers onto your wheels and have that custom spoke wheel look like those used on more expensive custom and racing cars. Wheel covers are crafted of chrome plated heavy gauge steel, enhanced with actual chrome plated lug nuts for authentic appearance. Each is perfectly balanced and is held securely in place with ten positive spring steel grippers.

For	Stk. No.	Per Set of 4
13" Wheels	567	$24.88
14" Wheels	568	
15" Wheels	569	

ADD $1.55 FOR POSTAGE & INSURANCE

Wheel Balancers For All Cars, Station Wagons & Light Trucks

only **$9.95** EA.

Pays for itself—built to last a lifetime. With permanent built-in level indicator, leveling screws.

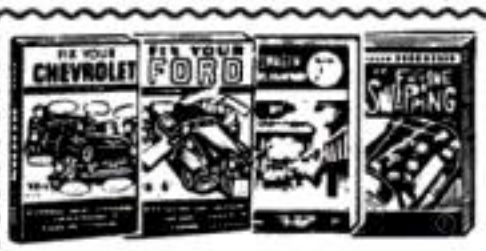
Any 4, 5, or 6-hole wheel can be balanced quickly, easily by anyone on this low-cost precision wheel balancer. Balanced wheels help prevent front end wear and damage; reduce uneven tire wear, increase tire life; give a safer, smoother, more comfortable ride.

Lightweight, portable, accurate wheel balancer. Has no moving parts—nothing to go wrong or wear out. You can use it on the spot or on any flat, fairly level surface. Use it to balance wheels when installing new tires, when installing or changing to or from snow tires. It's easy to use and is complete with four "centering heads" to handle any 4, 5, or 6 bolt wheel. Built of sturdy, yet lightweight aluminum and plastic—will give a lifetime of service.
No. 762—Each $9.95
ADD 85c FOR POSTAGE & INSURANCE

REMEMBER THAT OLD TIME
AH-OOO-GAH!
CHROME PLATED
HORN

POSTPAID As Low As **$11.44** EA.

Here it is . . . the same sounding klaxon-type horn once used in the renowned Model "A" Ford! Not a vibrator or other substitute but a genuine motor driven horn that operates just like a modern motor horn. Looks like, sounds like the original horn. **State 6 or 12 volt.**
Chrome Plated Bell with Black Wrinkle Painted Housing.
No. 60—Each. **POSTPAID**..... **$11.44**
All Chrome Plated Bell and Housing. Weatherproofed for outside mounting.
No. 63—Each. **POSTPAID**..... **$12.44**



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Contain time and money-saving short cuts and service information. Help you repair engines, transmissions, carburetors . . . rebuild older cars.

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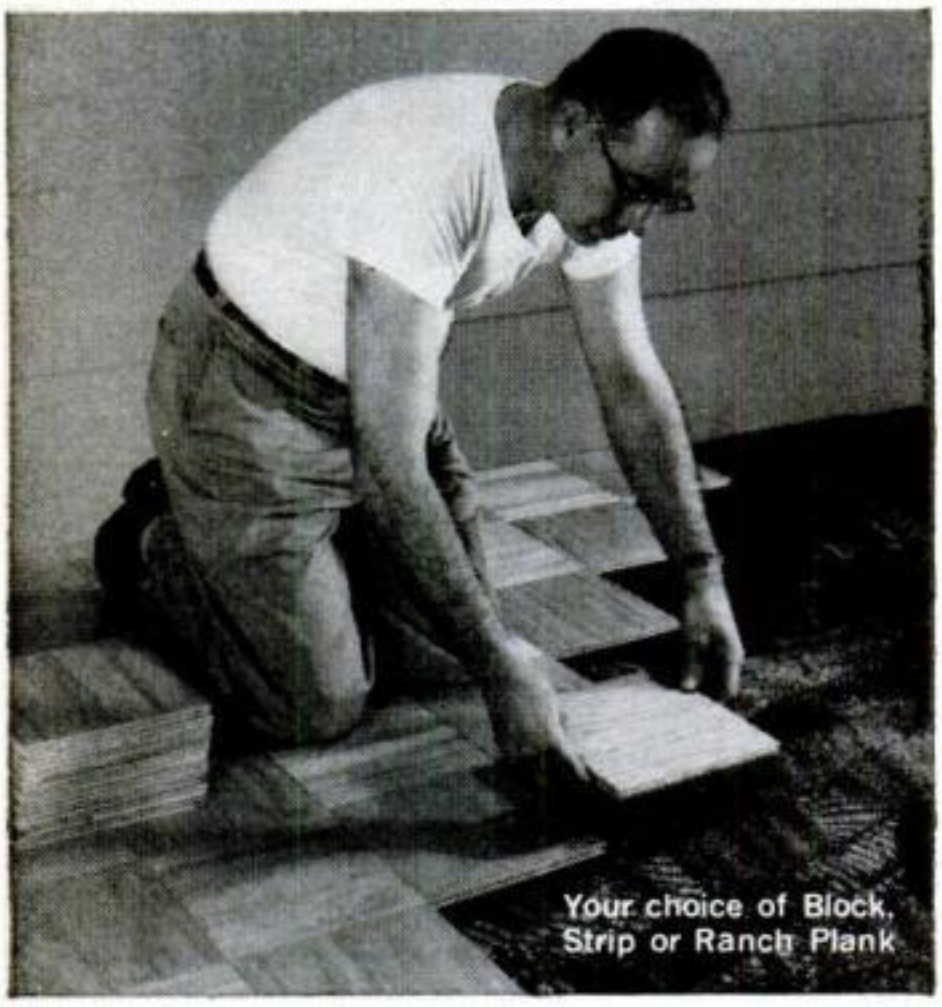

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BRUCE Prefinished Oak Floors

LBJ's Heart—and Yours

[Continued from page 77]

fats, really add to those plaques in the bloodstream? A day-by-day and death-by-death analysis of more than 5,000 men and women in Framingham, Mass., begun five years before LBJ's attack by our National Institute of Health, seems to show that it does.

Persons with a lower-than-average cholesterol level outlived those with a higher level.

Avoiding a high cholesterol level was one of the things advocated by N.I.S. to escape cardiovascular disease. Their other injunctions: No high blood pressure. No obesity. No cigarettes. Proper exercise.

Removing the stress. Tension is also thought to help raise both blood pressure and cholesterol in the blood. At the LBJ ranch, everything possible was done to eliminate stress. The senator bought a contour chair, listened to music, read, and played checkers.

"I'd never sat still since I was 27," he told a friend. "Now I've become more rested and peaceful inside than I can ever remember."

One of the Framingham findings had indicated the need for exercise. Johnson's mile walks were only a beginning. Later the prescription included a daily swim and a long hike. In the White House, he still swims twice a day and walks when he can. On one recent famous foot march, he led weary newsmen around the oval behind the White House for 15 consecutive laps—over four miles.

Four miles, by the way, is exactly the minimum amount of daily vigorous walking that Dr. Paul Dudley White prescribes for his patients.

Midway through LBJ's rehabilitation, another heart attack shocked the world. Three months after his visit to the ailing Johnson, President Eisenhower joined the cardiac club.

By December, after five months of recuperation, LBJ felt well again. He made a couple of speeches and took his daughters to a football game. He went to Atlanta where Dr. Hurst checked him from head to toe. After Christmas he flew to the Mayo Clinic in Minnesota.

The Mayo bulletin said: "His blood pressure, pulse, and EKG are those of a normal man. Barring unforseen compli-

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Comet roars from bottom to top of world to show it's still World's Durability Champion

Leaving Cape Horn Sept. 12, Comets slogged through spring mud. Later, cars tortured their suspension systems jouncing over 18-inch-deep ruts carved by trucks.

Despite rough going, these '65 Comets needed no major repairs during run.

Tres Arroyos, Argentina: one of the fine roads along the route the Comets took.

'65 "showroom" models make the historic 16,200-mile push in 40 days and nights.

Why did we do it? To show that Comet "can do." Last year, specially equipped Comets racked up 100,000 miles and the World's Durability Championship at Daytona. Now regular production '65 Comets have shown they're just as tough. We wanted to make sure you knew that. Now it's your move.

Mercury **Comet**

world's durability champion

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The safest, toughest jig saw made!

NEW from Porter-Cable—these tools are:

Shockproof—Constructed of non-conductive CYCOLAC—double insulated against electrical shock to conform with all Electrical Safety Codes.

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Jig Saw Model 60/2.5 Amp. (.24 HP) Motor/3300 SPM
Also available—¼" Drill, ⅜" Drill, Sander and Kits

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cations, there is every reason for him to return to his duties and to resume major activities."

A jubilant LBJ announced, "I'm returning to the Senate. I'm going to be sensible about it. I'm not going to try to do everything."

In Washington, he was ordered to sleep more, rest more, eat more wisely, and get more exercise. Then the doctors added another wrinkle to his regime—the short vacation: "Take eight or ten every year—weekends, holidays—and break the constant pressure." Those flights back to his ranch are not all for fun. They are doctor's orders. After six months, the Mayo Clinic checked him again and found that his EKG showed no sign of even a scar.

On the evidence, LBJ's problem was solved by medical science, but what people often forget is that science is based on logic, and logic is, after all, good sense.

Every man knows instinctively how he should live to be fit, but until angina pectoris squeezes him into a pretzel or coronary thrombosis knocks him into a collapse, he violates most of the rules. So the job of most medics is to catch their man when he is scared, as they finally caught Lyndon Johnson. Then they must save him, and later, perhaps, make him over.

Fortunately, they can now enlist a wizard's trunkful of gadgets and techniques. Some of the most useful are these:

The "demand" pacemaker. When disease weakens a heart so that it beats too slowly, blood may pool in the body and red corpuscles may clump and clot, or the heart may react in the opposite direction and begin to palpitate. Several years ago, medical inventors designed an artificial pacemaker that would normalize the heart's pumping rhythm by shooting its own current into tired muscle. Today almost 4,000 of these transistorized pacemakers are implanted within human bodies.

On occasion, however, a kind of warfare occurs between the real and the artificial pacemakers. A weary heart may suddenly begin to beat loud and clear or it may gallop into a kind of bongo beat. This conflict courts disaster. Today, a "demand" pacemaker can be tucked inside the chest where it sits mouse-still as long as the beat is normal. If the heart begins to race, or drag, the pacemaker turns itself on and

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Panel a dull wall this weekend-

for less than $50.

Say you've got about an 8′ x 12′ wall. You can panel it like an expert with Western Wood paneling. This isn't some sheet material. This is the real thing. With a real feel to it.

It's easy to work. Easy to nail. And easy to saw. Individual pieces fit around openings better. (One slip on a large sheet and goodby whole sheet.) Put it up horizontally, vertically or in a herringbone pattern. For a formal effect use a clear grade or uniform widths. Random widths look informal. Knotty grades are more casual.

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See your dealer. Say, "I want to panel a wall with Western Wood for less than $50." He'll put together a kit that'll include everything.

Or ask him for a Western Woods booklet of paneling ideas. If he doesn't have one, mail us 10c and this coupon. We'll send you one.

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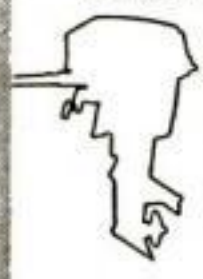
DESIGNED by FISHERMEN in ENGINEERS' CLOTHING

Because they're fishermen themselves, West Bend engineers know what fishermen want in an outboard motor. They've designed a new 9 h.p. outboard *especially for fishermen.* It's *light* — only 55 lbs.; *compact* — takes up 10% less trunk space than low silhouette models; *economical* — runs longer on less fuel. See it today at your dealer's (listed in the yellow pages) or write for full color brochure showing all West Bend outboards — 3½ to 80 h.p. It's *free.*

Total Quality



TOP TO PROP

West Bend®

DEPT. 1502, ENGINE DIVISION
THE WEST BEND COMPANY
Hartford, Wisconsin

takes charge, coming to its owner's rescue.

The defibrillator. Under some conditions, a sick heart will begin to flutter and vibrate without really contracting. Tiny beats up to 1,000 a minute have been counted. This is fibrillation; it is often a forerunner of sudden death.

In the 1950s, scientists discovered that a massive shock would subdue the electrical storms in the heart that caused fibrillation. Today, when a victim of coronary collapse is hustled into an emergency ward, his heart fluttering, the doctor wheels up a "defibrillator" and places two paddles the size of saucers on the patient's chest. When he orders "shock," a split-second blast of thousands of volts of electricity pours into the body.

One shock is often enough. The result is always akin to a miracle. Within minutes the patient may be bright-eyed and bushy-tailed, unaware that he momentarily had one foot in the grave.

Closed-heart massage. Sometimes the heart stops stone-cold. Doctors call this cardiac standstill. At first, surgeons would open the chest and hand-massage the heart until it began to beat again. Emergencies outside of hospitals usually resulted in death.

Standstill is usually caused by massive damage in the heart's tissue or coronary artery, electric shock, smothering, allergic reaction (to a drug or sting), or drowning. The pumping action must be started within four or five minutes or the brain may be damaged beyond repair. Today's method is to massage the heart through the chest wall, and anyone can be taught to do it.

The heart is massaged by pressing down hard on the elastic rib cage, squeezing the heart against the spinal column, and releasing the pressure, 100 times a minute.

Isotope tracers. A heart examination always seeks the location and extent of defects. Isotope tracers can give the answers. First, the cardiologist injects a material called thrombin. Circulating, it settles into invisible, scarified, fatty areas and begins to form clots. Next, he injects isotope-tagged antibodies that react with thrombin, seeking it out and surrounding the thrombin clots. Finally, the physician passes a scintillation scanner along the track of every blood vessel in the patient's body, listening to the steady ticking of its sensor. When the scanner begins to buzz, he knows he has hit a

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No matter where you march in this parade, you're a leader. Army training gives you the habit of leadership, gives you the confidence people respect.

Share great moments with other great guys

No wonder some of the greatest songs of all time have been marching songs—there's nothing as stirring as the feeling you're part of a great group moving as a perfect unit.

Unless it's the excitement of your first medal...or seeing a foreign country...or knowing you're serving *your* Country in one of its finest organizations.

And there are quieter satisfactions, too. Learning a valuable occupational specialty—the Army has hundreds to choose from. Developing your body, increasing your self-confidence, becoming more mature. Living a life made up of great moments.

Talk to your local Army recruiter. Let him help you find out if the Army is right for you ...and if you're right for the Army. The moments you spend with him may lead to that great moment when you discover that ...if you're good enough to get in, a proud future can be yours in today's *action*

Army

If you're good enough, you get full recognition in the Army. And think of how proud she'll be of you and your sharpshooter's medal.

Something to write home about...your experiences in the many fascinating cities and countries where American soldiers are stationed.

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Take pride in your personal touches? Like adding your own improvements? Then Shopmate tools are built for *your* home workshop. Built to industrial standards, yet designed for home use, these tools make tough jobs easy, every project fun, whether you work in a mansion or apartment.

Shopmate Electric "Zip-Screw" Driver: 100 to 1 gear ratio assures positive power. Instant release "on-off" switch. It's reversible. 3.0 amp Life-Weld motor. 3 bits furnished for # 4 thru #12 slot or Phillips head screws.

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"hot spot." A chart can then be drawn showing the location and extent of each damaged blood vessel, and treatment can be started.

Catheterization. A heart catheter is simply a slender tube slightly thicker than a hatpin. In Germany, in 1929, Nobel prize winner Dr. Werner Forssmann proved that such an instrument could be inserted into an arm vein and manipulated until its tip reached the heart. He did it first in his own body.

The method has since been refined until the catheter is now a versatile tool that can be used to draw blood samples from inside the heart, measure pressure in its chambers, or detect the kind of unwanted openings between adjacent compartments that cause blue babies.

The long-distance electrocardiogram. "The electrocardiogram remains the most important, single diagnostic tool available," says Dr. Leroy E. Burney, a former U. S. Surgeon General. The EKG or ECG (they're the same) is the paper tape on which an inked line reflects the movements of the heart. Over the years, the basic pattern has been identified and standardized by doctors.

The diagnostic value of the EKG has recently been extended by sending and receiving machines which, when hooked to a long-distance line, reproduce a tape thousands of miles away. If a doctor needs help in interpreting certain puzzling peaks and valleys, he simply puts in a call, hooks up his tape machine, and stands by. The cardiologist he consults inspects the EKG being reproduced on his own machine and delivers an expert opinion.

Artificial heart valves. The heart has four important valves for controlling the blood flow. An astonishing number of persons have valves that are no good. Rheumatic fever is the great wrecker. The only relief comes with replacement by a man-made valve.

Most of these techniques and much of this hardware have come into being since the year of LBJ's attack. But the unwounded heart of the average young man is still in jeopardy. The answer is common sense.

The President says: "I've learned my lesson." Looking at the vigorous man who strides around the White House lawn, most observers are sure that he has. ■■

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- $ 39 Hyd. Cyl. 3" x 8" 2-way 19.95
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● **Item #311.** Expensive 12-v Gov't. reversible, ball bearing 2000-lb. capacity winch. Holds 40' ¼" cable. For trucks, docks, boats, etc. Cost $250. SALE **$49.95**

Many other types battery winches-hoists.

AIR COMPRESSOR EQUIPMENT

● Make your own outfit. For painting, tires, shop use, etc. Save to 60%. ● Compressor **$19.95.** Govt Tank **$11.95,** Gauge **$1.75,** Paint Gun **$10.50,** Auto Switch **$4.35,** Air Regulators **$3.95,** Air Filter **$3.75.**

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● **Item #716.** Std. phone, same used on all phone systems. Use as extension to main phone and on private systems. Directions furnished. Wt. 8 lbs. Cost $25.00. SALE..... **$7.95**

AC-DC ELECTRIC GENERATOR

● **Item #675.** Generates 115-v, (800-cycle) AC (1200-w) and 30-v up to 200 amps DC. Use for 115-v AC lights or for DC welder. Size 14"x 8"x6". Wt. 55 lbs. Govt. cost $250, SALE **$15.85**

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- $ 31 H-speed ½ h.p. DC 12-v Motor .. 3.97
- $ 90 Selsyn 115-v 60-C Motors (pair) . 7.91
- $ 45 Variable Voltage Transformer AC 2.39
- $ 99 Jeep Capstan Winch 33.95
- $ 75 Gov't Centrifugal Pump 1½" Outlet 23.81
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- $ 75 Automatic Motor Keying Unit 3.95
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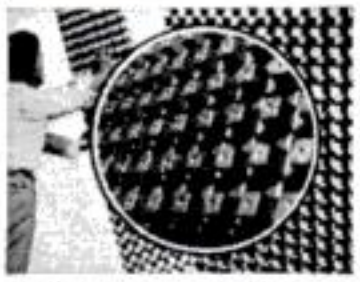

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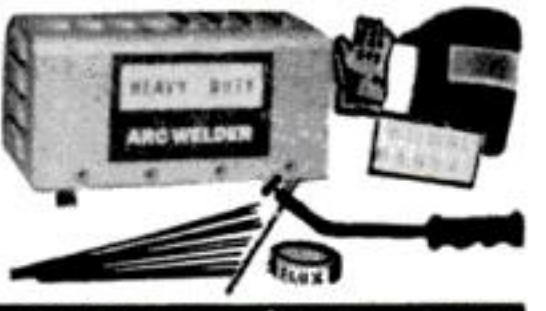

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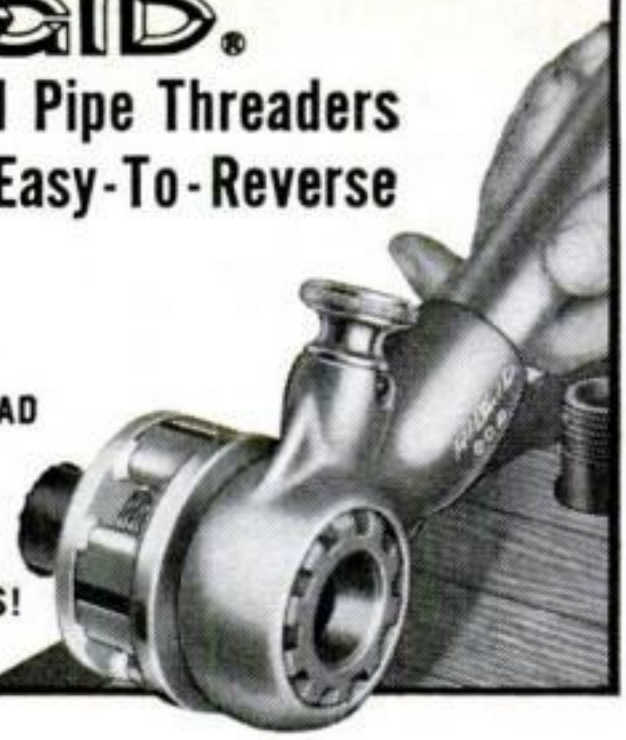

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More Danger in a Small Car? Yes!

[Continued from page 72]

again. Rollovers account for 47 percent of small-car accidents, only 21 percent of standard-car accidents. You might blame this on the small car's predominantly younger drivers.

The ACIR report hints that the real factor in rollovers might be not so much car size as engine placement or chassis design. It does not break down figures by car make, but the Indiana State Police study does. In 913 accidents involving Corvairs, Falcons, Larks, and Volkswagens, the two rear-engine cars came off worse: VWs rolled every third time, Corvairs every fifth time. The front-engine Falcons rolled every sixth time, Larks every thirteenth.

Despite the rollovers, small cars get badly banged up less frequently than big cars. This seems like a score for the bugs until you look more closely at the way ACIR compiles figures. It counts only accidents that cause personal injuries. This suggests that many moderate-damage smashes produce injuries in small cars (and swell the figures for small-car moderate damage). The same type of accident may produce no injuries in a big car and so would never even be added into the statistics.

The risk of an accident in a small car appears to come out even: no decision on the number of accidents, but more young drivers; more rollovers, but less severe damage. Not so with injury risk.

Are they death traps? ACIR pulled some statistical jiggery-pokery here to get a fair and meaningful answer. First it selected comparable accidents, matching severely damaging crashes in big cars to similar crashes in small ones, and so on through the list. Then it "adjusted" the average injury rates to make up for the greater proportion of severe standard-car smashes. Otherwise small cars would have an artificial advantage on injury rates just because they were involved in fewer severely damaging accidents (and an artificial disadvantage in ejection rates because they were involved in more rollovers).

This adjustment increases the injury rates in small cars but is nonetheless honest. It puts both types of car on an even basis and tells you what you really want to know: In a particular kind of accident, what are your chances in a small car relative to your chances in a big one?

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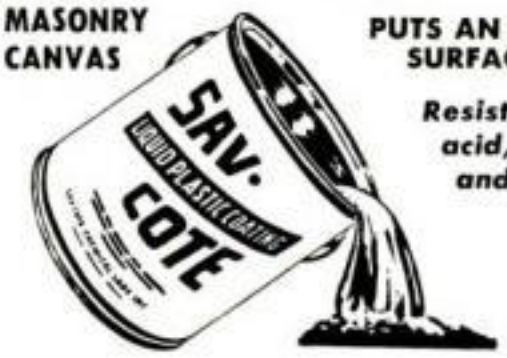

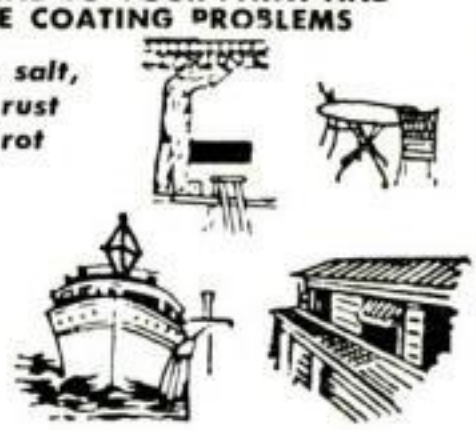

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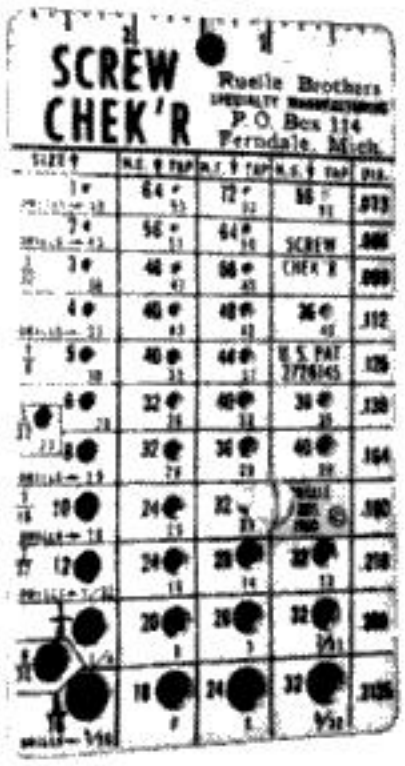

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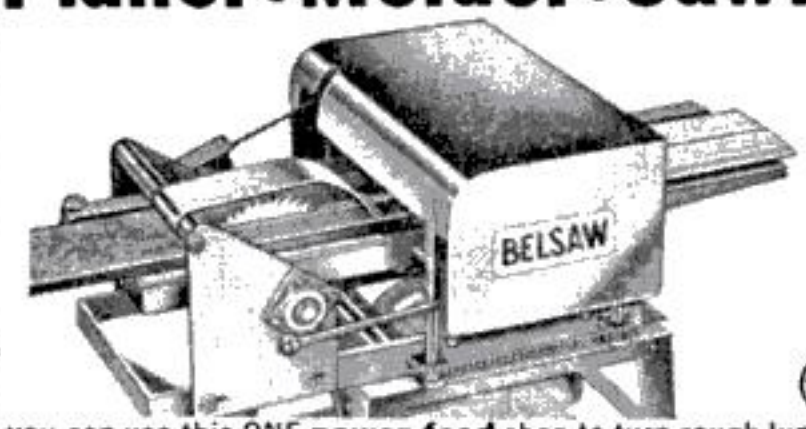

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Concludes ACIR: "In the most severe accidents the car weight may make the difference between life and death, for in these accidents 46 percent of small-car occupants were killed, as contrasted with 26 percent of standard-car occupants."

Yet weight as such is a life-or-death influence only for small cars as they are built today, points out Dr. Campbell. Small cars are rarely crushed. In many of the accidents, passenger compartments survived intact. The passengers might have survived, too, he adds, if they had been protected by safety door latches, smooth interiors, and shoulder harnesses. ■■

More Danger in a Small Car? No!

[*Continued from page 73*]

"Injury and fatality figures back up the experts in saying that driver actions account for the vast majority of auto accidents. Of the 42,700 persons killed in highway mishaps in 1963 . . . 80 percent were caused by 'actions of drivers,' according to Travelers Insurance . . ."

The significance of this is that—on Cornell's own testimony—the median age of drivers of small cars covered in the report was 27 years; compact cars, 30.3; and standard cars, 33.6. Younger drivers, of course, are more often involved in accidents, as the insurance rates by age groups attest. As a factor in accidents, where do these figures leave the statisticians who "adjust" the percentages?

And soft tops: If the compilers of the report insist on including persons pitched out in collisions and rollovers, how do they

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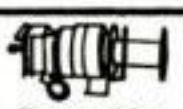

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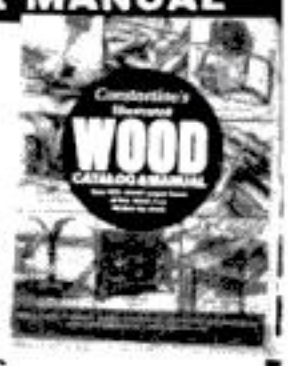

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More Danger in a Small Car? No!

"adjust" for convertibles—an estimated 25 percent among the small cars, as against less than 10 percent among compacts and standard cars?

In the period covered by the report, a quarter of the small European imports mish-mashed by Cornell into statistics were convertibles. Detroit had not yet put compact convertibles on the market, and overall convertible production here was less than 10 percent of car output.

What of agility? Again quoting my son, "The report doesn't say anything about the ability of a small car to stay out of trouble. It's more maneuverable."

But Renault does. It quotes Dr. James L. Malfetti, director of the Safety Education Project of Columbia University's Teachers College (New York), as saying, ". . . the chances of staying out of an accident are better in a small car."

The report double-talks. It includes 26 tables that mention rollovers as a source of injury or death. The study's "average adjusted fatality rate" in percent for small cars in rollovers, *with or without collision,* is 8.3, and for compacts 8.5. The susceptibility of the smaller car to rollover is heavily underlined.

On page 55 then occurs this sentence: ". . . within the serious injuries there are differences which cause collisions with vehicles to emerge as the most fatal accidents, rollovers without collision as the least fatal accidents."

It's the statistical "adjustments" that bug me. Dr. Jaakko K. Kihlberg, senior analyst of the project, in an interview said, "We use standard statistical procedures."

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$$N;\ N = \sum_i\ n_i{}^{\circ}$$

You figure that one out. ■■

°For Mr. Francis' edification, this formula, lifted out of context from the appendix, is simply a scientific way of testing the significance of rates given in the report. It expresses the definition of the variance, *which is the statistical term meaning the expected square of the deviation from the mean (or what is called "the second moment about the mean"). "p_s" is the probability of an event occurring, and hence 1-p_s of its not occurring. "N" is the total number of trials, which is expressed as the sum of different numbers of different samples. The variance is a measure of how much an* estimate *of a mean (or average) due to sampling is likely to deviate from the true mean. The formula is one of many tools a scientist uses to make sure he doesn't fall into some of the errors of "common-sense" statistics—the kind Mr. Francis uses.*

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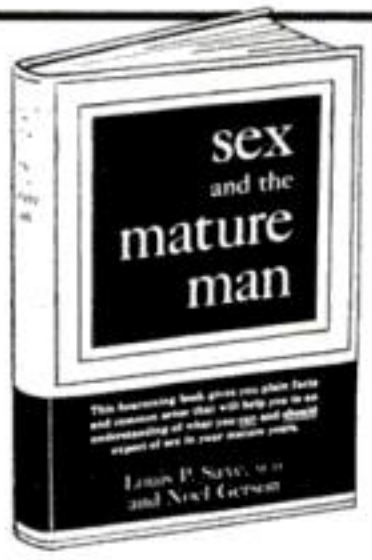

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What Happened to Manned Space Stations?

[Continued from page 89]

stallations. Consider a TV broadcasting satellite in a synchronous orbit—a station, seemingly standing still in the sky, to which anyone on earth below can tune his receiver. Several hundred kilowatts of transmitting power would be required. It may well prove to be economical to furnish a station so complex and powerful with a permanent maintenance crew, which would be exchanged at periodic intervals.

● A deep-space assembly site and jump-off platform for manned expeditions setting out to land on other planets. Such missions will require nuclear-powered spaceships, assembled and fueled in a low earth orbit from sections and propellants brought up by chemical earth-to-orbit freighters.

When we set out to design a space station, however, we face a strange paradox. To keep a man alive in outer space, we have to put a barrier between him and space—a pressurized cabin or suit—but it must not deprive him of the very gains he sought in space. If he cannot effectively observe the earth beneath him or the universe about him, he'll be like a man trying to study undersea life from a windowless submarine.

A related problem is raised by the question of possible ill effects from a long period of weightlessness.

Early space-station designs called for doughnut- or dumbbell-shaped stations rotating slowly about their hubs, so that centrifugal force would replace at least part of the missing gravity. But a spinning platform would handicap observers of the heavens and the earth, since telescopes require a steady aim.

Must space stations spin? We still do not know whether artificial gravity will be necessary from the medical point of view—and, if so, whether a daily five-minute spin in a small centrifuge built into a non-rotating space station might not suffice to make both the astronaut and the doctor happy. But the coming Gemini orbital flights, of up to two weeks' duration, will tell us a great deal about man's ability to endure weightlessness for longer periods.

In any case, artificial gravity undoubtedly would add to the comfort of everyday life in a space station. So a rotating design looks attractive for a manned TV station in space, and for the crew quarters of an assembly station for expeditions to other planets. For such long tours of duty, com-

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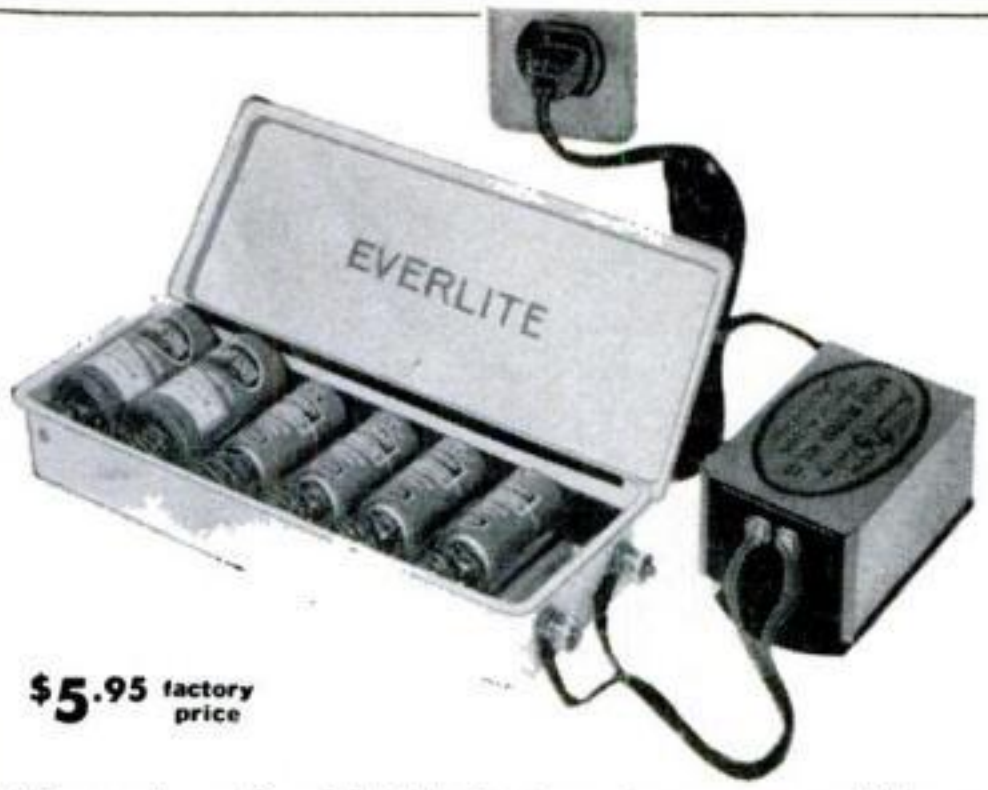

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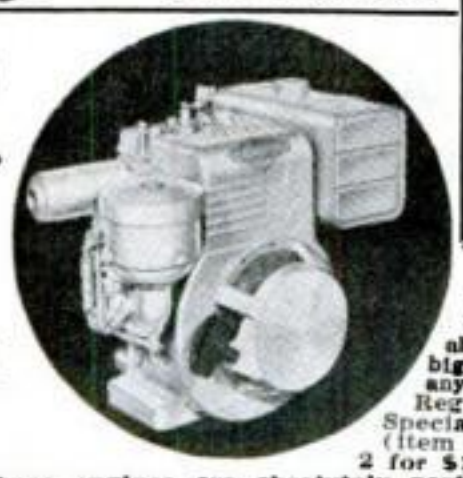

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What Happened to Manned Space Stations?

fortable living quarters for the crews will probably take precedence over suitability for scientific observations.

Space stations thus may differ in design according to their respective purposes. Likewise, their uses may dictate orbits of widely different types.

Unless the mission specifically calls for a high orbit, a low one offers the general advantage of lower earth-to-orbit transportation cost. A low west-east orbit, only slightly inclined to the equatorial plane, is particularly economical: It gives a rocket ship, at launching, full advantage of the "boost" resulting from the earth's west-east rotation. Such an orbit would best suit a space station intended as an astronomical observatory—or as a physical and life-science laboratory. A relatively low polar orbit, in contrast, seems advantageous for earth surveillance, since it would enable an observer to see every point on earth at least twice in 24 hours.

For an assembly site for deep-space expeditions, a low orbit in the equatorial plane offers certain advantages. And a TV station "fixed" in space automatically calls for an equatorial orbit, with the added requirement of a 24-hour orbital period (which, in turn, sets the required orbital height at about 23,000 miles).

The answer: many stations. To sum up, manned space stations are bound to come. Because of their varied potential uses, and different requirements, it seems likely that we shall have not one but a number of space stations—and that, in due time, other countries will have theirs, too.

It may well be, however, that several mission assignments for future manned space stations can be combined and served by one central station, when all participants can agree on an identical orbit. To reconcile the missions' different needs as to design, the orbiting space center may consist of a group of small free floating "mission" stations, clustered about a spinning doughnut or dumbbell that will serve as a combination hotel, restaurant, and office for the entire complex. ■■

Dr. von Braun will consider answering questions from readers of POPULAR SCIENCE in the magazine, but he cannot undertake to answer each one by mail. Letters to him should be addressed in care of POPULAR SCIENCE, 355 Lexington Ave., New York, N.Y. 10017.

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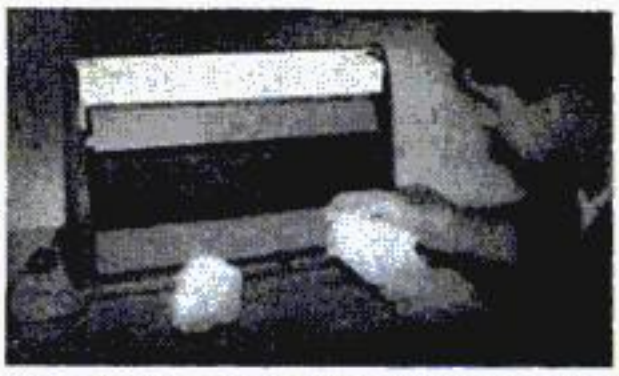

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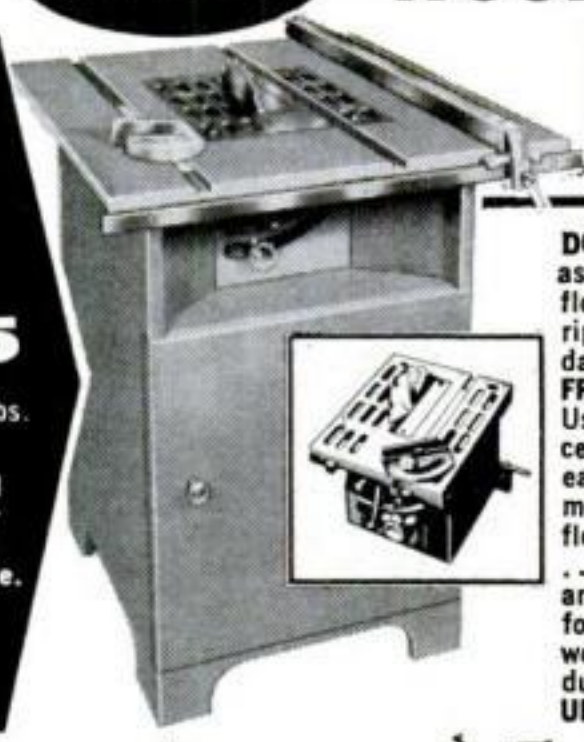

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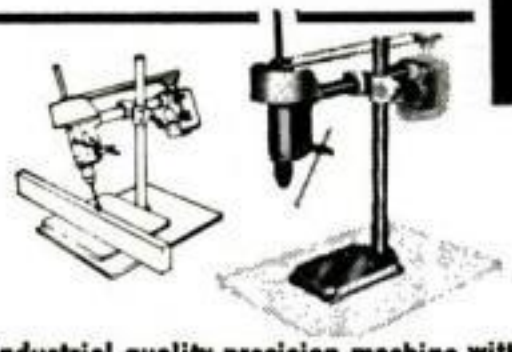

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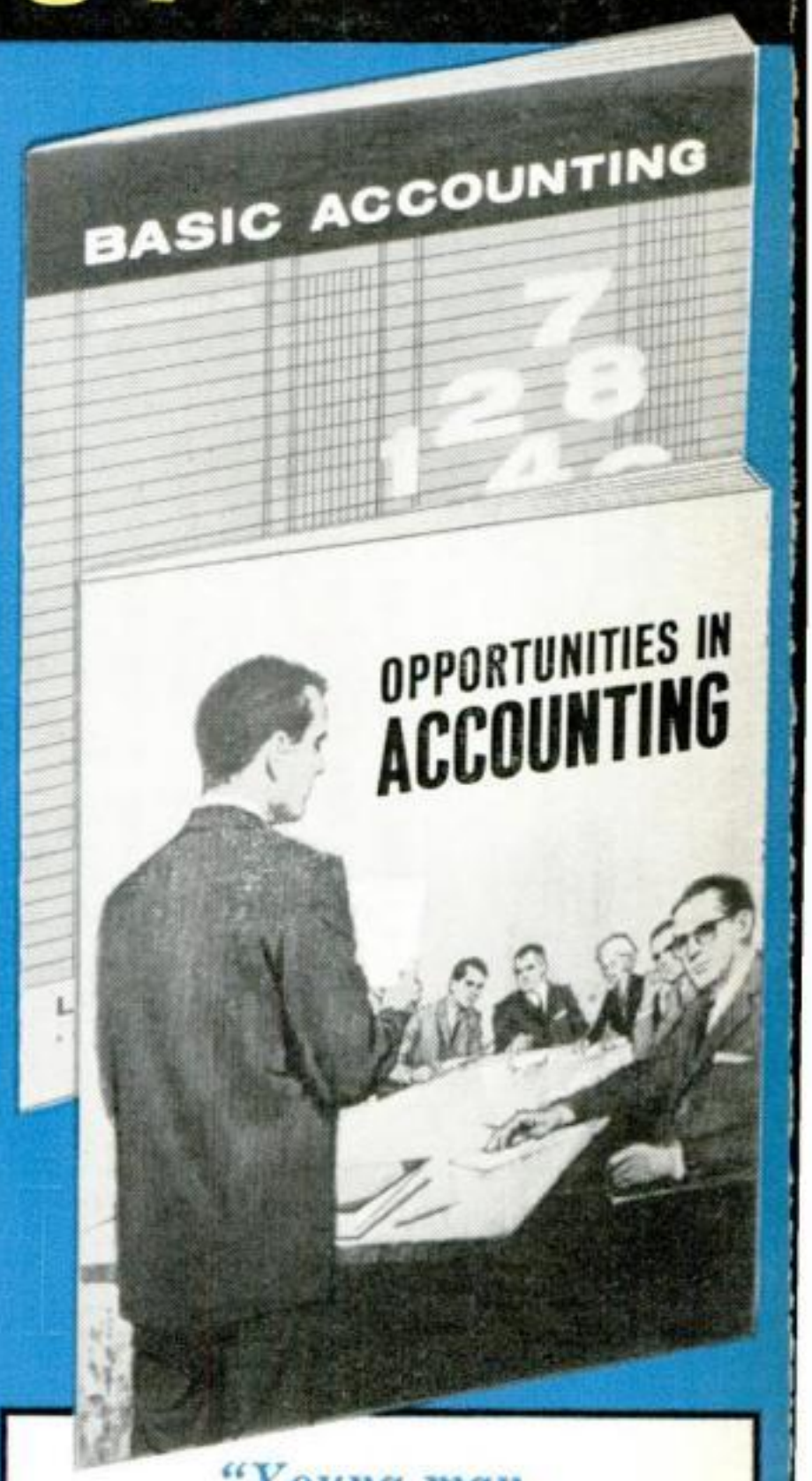

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